2015 Oyster Stock Assessment Report

of the Public Oyster Areas of Louisiana

Seed Grounds and Seed Reservations

Oyster Data Report Series No. 21
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***Cover Photo:** LDWF research vessel heading out to survey oyster luggers working the Round Island cultch plant in Mississippi Sound during the fall of 2015.

Statewide Overview - 2015 Oyster Stock Assessment

Introduction

The Eastern oyster (*Crassostrea virginica*) resource in Louisiana is one of the largest and most valuable in the nation. Its value is derived from both the economic benefits it provides to the state and the ecological benefits it provides to the estuarine environment. Due to Louisiana's vast coastal wetland area, ample habitat exists where oysters thrive under a variety of environmental conditions. The Department of Wildlife and Fisheries (LDWF) is charged with managing the oyster resource on the public grounds by closely monitoring the size and health of oyster populations on nearly 1.7 million acres of public water bottoms (see map on page ix). Oyster management on these public grounds includes activities such as setting oyster seasons, monitoring harvest levels, and habitat enhancement (i.e. cultch planting, reef building) projects.

Typically, the oyster industry utilizes the public oyster grounds as a source of seed oysters (< 3") for transplant to private leases. The public grounds also yield a supply of sack-sized oysters (≥ 3") and these oysters may be taken directly to market. The manner in which both the public grounds and private leases are utilized in combination helps to keep Louisiana's industry as a national leader in oyster production with annual value as high as $67 million worth of dockside sales in recent years.

Oysters also play an important ecological role in the estuarine ecosystem. Oyster reefs provide the majority of hard substrate required by other sessile invertebrate species such as barnacles, bryozoans, tunicates, and anemones. Reefs are also utilized as shelter and forage habitat for many species of crabs, worms, fish, and numerous other macro- and meiofauna. Estuarine water quality can be enhanced by the filter-feeding activities of oysters, and reefs can also play a role in stabilizing shorelines.

Louisiana Oyster Landings

Oysters have been a part of the Louisiana economy for many years and support a multi-million dollar industry. Louisiana regularly leads the nation in the production of oysters and accounted for an average of 34% of the nation's oyster landings over the 1997 – 2013 time period (Figure 1). After depressed oyster landings in 2010 totaling under 7 million pounds, Louisiana has harvested over 11 million pounds in each of the last four years, including 12.6 million pounds in 2014 (preliminary LDWF data). Among Gulf of Mexico states, Louisiana consistently ranks #1 in landings and accounted for nearly 60% of all oysters landed in the region in 2013[1].

The public oyster grounds can be considered the backbone of the Louisiana oyster resource. These grounds are a valuable contributor to overall Louisiana oyster landings each year, while also supplying seed oysters transplanted to private leases for grow-out purposes. The trend from 1970 – 1992 showed the majority of Louisiana oyster landings came from private reefs. From 1992 to 2001, however, the public ground stock size increased, in general, and landings from the public grounds increased as well. In 2008, harvest levels significantly increased on the public grounds over 2007 levels and the public grounds produced approximately 47% of all oyster

[1] Finalized state-by-state landings for 2014 were not available from the National Marine Fisheries Service (NMFS) at the time of this publication, so data comparisons between Louisiana and other states were not possible.

landings for the calendar year. This reliance on the public grounds reversed during the 2009-2014 time period and preliminary harvest data showed that over 90% of all oysters landed in Louisiana came from private leases in 2014 (Figure 2).

Statewide Oyster Stock Assessment Overview

Methods

During the summer, LDWF biologists from each Coastal Study Area (CSA) of the Fisheries Division perform quantitative evaluation of the oyster resource on the public oyster areas (Figure 3). This biological evaluation includes using SCUBA to collect oyster samples from within a square meter frame from multiple locations (sample stations) in each public oyster ground. At each station, five replicate square-meter quadrat samples are collected and data is combined to produce average numbers of spat, seed, and sack oysters per station. Recent cultch plants (less than 2 oyster seasons old), however, are typically sampled by collecting five random ¼ meter-square quadrat samples. Spat are young oysters measuring one to 24 millimeters (mm) in length. Seed oysters measure 25 to 74 mm and sack oysters (market-size) measure 75 mm and above. The numbers of oysters per station is then multiplied by the associated reef acreage to obtain an estimate of the total oysters present on the reefs. Oyster mortality estimates are also generated by dividing the total number of recently dead animals by the total number of animals (both live and dead) collected. Sampling undertaken as part of the annual stock assessment plays a valuable role in predicting the success of the upcoming oyster season, which generally opens in early September and runs through April of the following year (although the season may be closed or delayed if biological concerns or enforcement problems are encountered). This stock size information is used to make recommendations to the Wildlife and Fisheries Commission for the setting of the oyster season.

A total of 110 sample stations were visited by LDWF biologists during the 2015 assessment and 550 individual samples were gathered. Sampling data are presented by CSA. During this year's stock assessment sampling, Coastal Study Area 1 South had the most sample stations (31) while CSA 5 East held the fewest (3). A higher density of sampling occurs in the Black Bay (CSA 1 South) and Sister Lake (CSA 5 West) areas due to their high level of oyster production in past years and historical importance to the oyster industry. During the 2015 assessment, 10 of the 110 stations were located on newly-constructed cultch plants (cultch plants constructed since 2011).

Annual Stock Size

The statewide oyster stock size in 2015 decreased over 2014 levels as approximately 1,115,484 (±323,384) barrels of oysters are available on the public oyster areas of Louisiana this year (Table 1). Unfortunately, this stock size represents an approximate decrease of 40% from 2014 levels, and the comparison of the two estimates shows a significant statistical difference. The 2015 statewide stock availability, just as in 2014, is heavily influenced by oyster stocks in the Mississippi Sound area (CSA 1), but still remains well below the long-term mean of 3.29 million barrels (Figure 4)[2]. Both seed and market-size oyster stocks decreased by approximately 40%

[2] Oyster stocks in Sabine Lake have only been assessed from 2010 to present, and are, therefore, only included in statewide totals since 2010.

statewide (Figure 5), and seed oyster stocks were below 2014 levels in all CSAs. Market-size oyster stocks showed increases in CSAs 1, 3, 5E, and 5W.

Table 1. Estimated Statewide oyster stock size on the public oyster areas of Louisiana. CSA denotes Coastal Study Area. Percentage columns (%) indicate percent of statewide total. Data in **barrels** and 1 barrel = 2 sacks.

CSA	Seed	Seed %	Sack	Sack %	Total	Total %
1N	336,732	54.8%	171,735	34.2%	508,468	45.6%
1S	5,059	0.8%	45,572	9.1%	50,631	4.5%
3	9,267	1.5%	8,397	1.7%	17,663	1.6%
5E	1,363	0.2%	710	0.1%	2,054	0.2%
5W	141,923	23.1%	58,615	11.7%	200,539	18.0%
7	119,646	19.5%	216,484	43.2%	336,130	30.1%
Total	***613,975***	***100%***	***501,509***	***100%***	***1,115,484***	***100%***

The oyster stock in CSA 1-North showed an approximate 14% decrease in size compared to 2014 at 508,468 (±236,715) barrels. This decrease was driven largely by a reduction in seed oyster stocks which fell 23% over 2014 levels to 336,732 (±101,577) barrels; however seed stock size is 26% above the 10-year mean. The market-size oyster stock is estimated to be 171,735 (±53,329) barrels, an increase of approximately 12% compared to 2014 and largest the market stock size since 2009; however market stock size is 5% below the 10-year mean. The largest contributor to the seed oyster stock is the Three-Mile Pass 2013 cultch plant (41%), and the Drum Bay 2013 cultch plant contributed most to the market-size oyster stock (46%).

Oyster production on public grounds in CSA 1-South appears to be seriously impaired. The current oyster stock size is only 50,631 (±22,285) barrels, down 41% compared to 2014 and down 96% from the long-term mean. This decrease was driven by an 83% reduction in the seed oyster stock compared to 2014, estimated at only 5,059 (±1,868) barrels. The market-size oyster resource showed a 19% decrease compared to 2014, estimated at only 45,572 (±20,418) barrels. Alarmingly, no spat or seed oysters were found on any reef complexes; seed oysters were only found on the Lake Fortuna 2012 cultch plant (which contained no spat). Only four of the twelve reef complexes were estimated to have any oyster resource.

Public oyster resource trends west of the Mississippi River in the Barataria-Terrebonne estuary are largely driven by oyster availability in two public oyster seed reservations – Hackberry Bay and Sister Lake. The current oyster stock size in the Hackberry Bay Public Oyster Seed Reservation (CSA 3) is 17,663 (±6,344) barrels; a 52% decrease in total stock size compared to 2014. Seed oyster availability in 2015 decreased 74% to 9,267 (±3601) barrels and is 14% below the 10-year mean; however the market-size oyster stock size increased 371% to 8,397 (±2,743) barrels and is 144% above the 10-year mean. The decrease in seed resource was driven by low seed production at all stations, where the increase in market-size oyster stock size was driven by the 2008 and 2012 cultch plants that combined to hold 95% of the total market-size oyster stock.

The size of the oyster stock in the Sister Lake Public Oyster Seed Reservation in 2015 decreased 34% compared to 2014 levels and is estimated at 198,952 (±18,152) barrels. The seed oyster stock decreased 48% to 141,034 (±9,912) barrels, but is only slightly below the long-term mean (6%). The market-size oyster stock increased 73% to 57,919 (±4,998) barrels; however this is 50% below the long-term mean. The Sister Lake 2012 cultch plant continues to be productive, containing 88% of the available seed resource and 85% of the available market-size oyster resource.

Public oyster areas in CSA 7 (Calcasieu and Sabine Lakes) accounted of over 30% of the statewide oyster resource in 2015 (Table 1, Figure 6) and the oyster stock size in Sabine Lake (258,527 ± 31,106 barrels) is over three times greater than Calcasieu Lake (77,604 ± 10,424 barrels). The oyster stocks in Sabine and Calcasieu both decreased in 2015 compared to 2014. Seed and market-size oyster stocks in Sabine Lake fell 40% (77,728 ± 9,227 barrels) and 64% (180,799 ± 21,880 barrels) respectively, and seed and market-size oyster stocks in Calcasieu Lake fell 66% (41,918 ± 4,974 barrels) and 62% (35,685 ± 5,451 barrels) respectively.

2014-2015 Commercial Harvest Season

Estimated commercial harvest increased during the 2014/2015 oyster season (Table 2) as compared to the previous season and was largely due to the successful oyster season in the Mississippi Sound area (CSA 1 North) where a strong 2014 fall spat set and 5-day 2015 spring season yielded 111,434 barrels of seed oysters and 16,372 sacks of market oysters. This equates to a 20-fold increase in total harvest for the Mississippi Sound area compared to the previous season. The overall decrease in market oyster harvest can be attributed to the typical biannual closure of the Sister Lake POSR and the closure of the Hackberry Bay POSG during the 2014/2015 season. Increased market oyster harvest was observed in CSA6 and Calcasieu Lake. The Louisiana Department of Health and Hospitals opened Harvest Area 25 in CSA6 which resulted in 30,051 sacks of market oysters (almost a 10-fold increase compared the previous season). Harvest in Calcasieu Lake was again restricted to the West Cove portion of the lake, yet harvesters were able to produce over 55,000 sacks of market oysters during the 2014/2015 season (almost a 40% increase compared to the previous season).

Table 2. Harvest estimates for the 2014/2015 oyster season on the public oyster grounds of Louisiana. Data derived from fisheries dependent surveys of harvesting vessels (=boarding reports) and not from LDWF Trip-Ticket data. Percentages indicate the change from the previous season. 1 barrel = 2 sacks.

CSA	Seed Oysters (barrels)	Market Oysters (sacks)	Total (barrels)
1 North	111,434	16,372	119,620
1 South	14,500	8,351	18,676
3	0	0	0
5 East	0	0	0
5 West	1,175	3,837	3,094
6	19,905	30,051	34,931
7	0	55,347	27,674
Total	***147,801 (+235%)***	***114,005 (-16%)***	***204,804 (+82%)***

Special Oyster Management Projects

LDWF biologists continue to participate in several important projects aimed at increasing oyster production on the public oyster seed grounds and reservations. Cultch planting is a reef rehabilitation method employed by LDWF since 1917 and three cultch plants were constructed since the 2014 stock assessment. LDWF hosted the grand opening of the Michael C. Voisin Oyster Hatchery at the Fisheries Research Laboratory on Grand Isle, LA in August 2015. Additional projects include continued evaluation of shell-budget modeling efforts.

Cultch Planting

Three small cultch plants were constructed in Calcasieu Lake in June 2015 totaling 65 acres. The cultch plants are located in the northern portion of West Cove (25 acres), near Lambert's Bayou (20 acres), and off Commissary Point (20 acres). Cultch plants were sampled in the fall of 2015 and showed successful spat settlement at all three locations.

Hatchery Activities

The hatchery is designed to produce at least 1 billion oyster larvae per season for wild population enhancement and to support the alternative oyster culture (AOC) industry. The hatchery also conducts and assists with academic oyster research. Larval production in 2015 focused on test broods for examining hatchery protocols for the management of water quality, algal production, and other systems. Approximately 313 million oysters were produced in 2015, with over 280 million oyster larvae and 1 million seed deployed by LDWF at sites in Hackberry Bay and Calcasieu Lake and over 32 million oysters produced for AOC operations and research purposes. Results from a 12-month pilot project showed that deploying hatchery-raised spat-on-shell is a viable method for supplementing spat on public oyster reefs, with survival rates ranging from 0.3 to 5.0%, exceeding some estimates of natural survival. The techniques developed for this project will be used at a large scale remote-setting facility in Buras, LA in future years.

Recent Legislation

The 2015 regular legislative session included two bills with a direct tie to oysters. House Bill 341 was passed as Act 211 and provides additional penalties for unauthorized taking of oysters from leased acreage. House Bill 579 was passed as Act 343 and increases lease rental rates for oyster leases from two dollars per acre to three dollars per acre starting January 1, 2016.

Conclusion and Acknowledgements

The following report includes both biological stock assessment and historical oyster landings data from each CSA in Louisiana, as well as a brief report on the most recent oyster season in each area. Biological data was generated from quantitative square-meter sampling (see above) and landings data was generated from field boarding runs and trip ticket information. Many hours were spent by the biologists of each CSA, both in gathering the samples and producing the report. Additionally (listed in alphabetical order), Patrick Banks, Harry Blanchet, Denise Kinsey, and Ty Lindsey greatly assisted with editorial review and preparation of this document. The efforts of both the field and office staff are greatly appreciated as this report could not be produced without the hard work and dedication of these many people. Questions and/or comments can be directed to Steve Beck at 225.765.2956 or sbeck@wlf.la.gov.

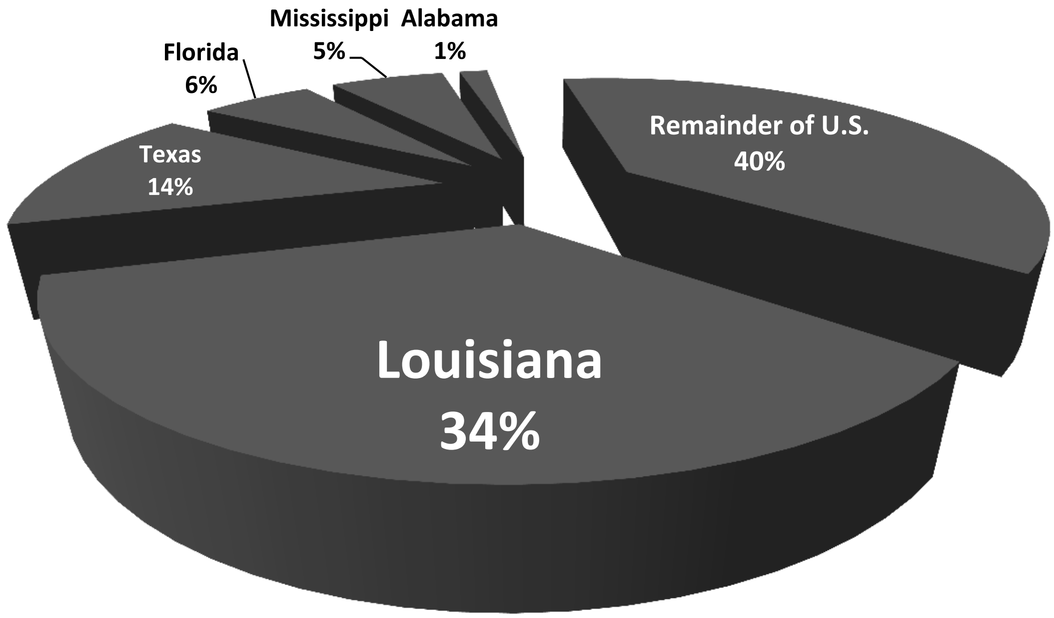


Figure 1. Percentage contribution to average annual landings of all oysters in the United States over the time period of 1997 through 2013. Data provided by National Marine Fisheries Service (NMFS).

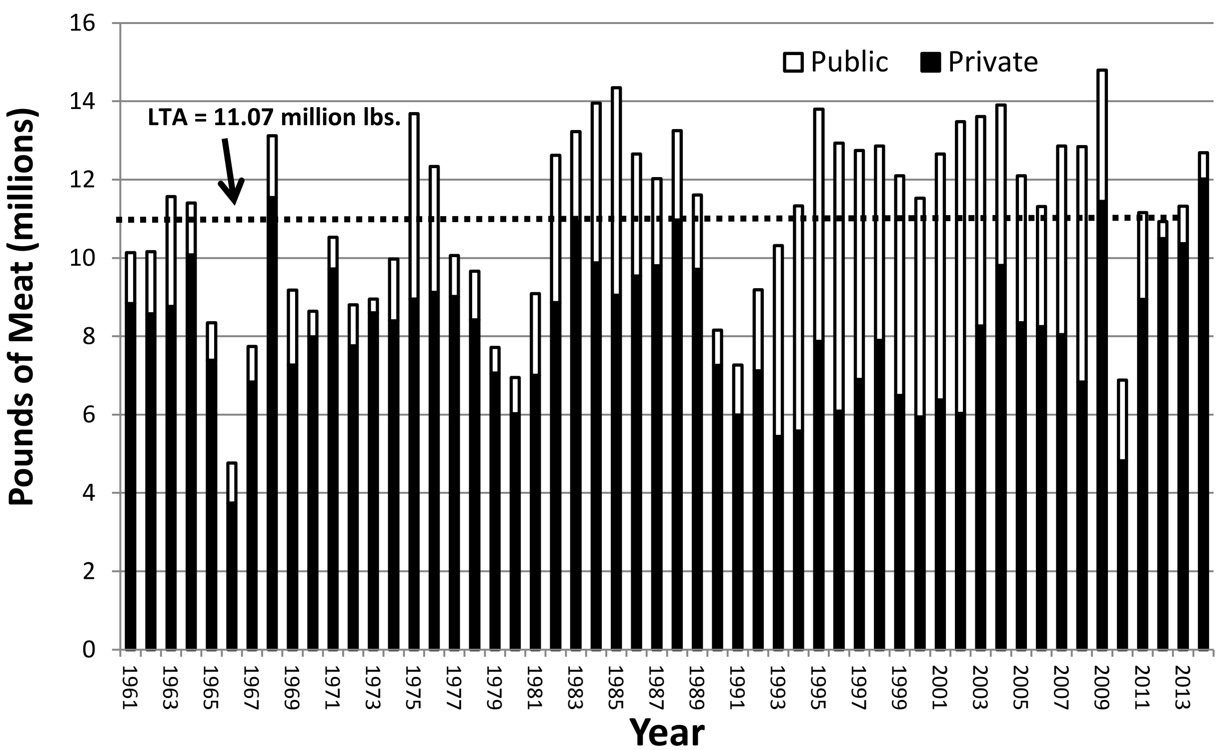


Figure 2. Historical Louisiana oyster landings for the public oyster areas and the private oyster leases (LDWF and NMFS data). 2014 harvest from private leases accounted for approximately 94% of that year's total.

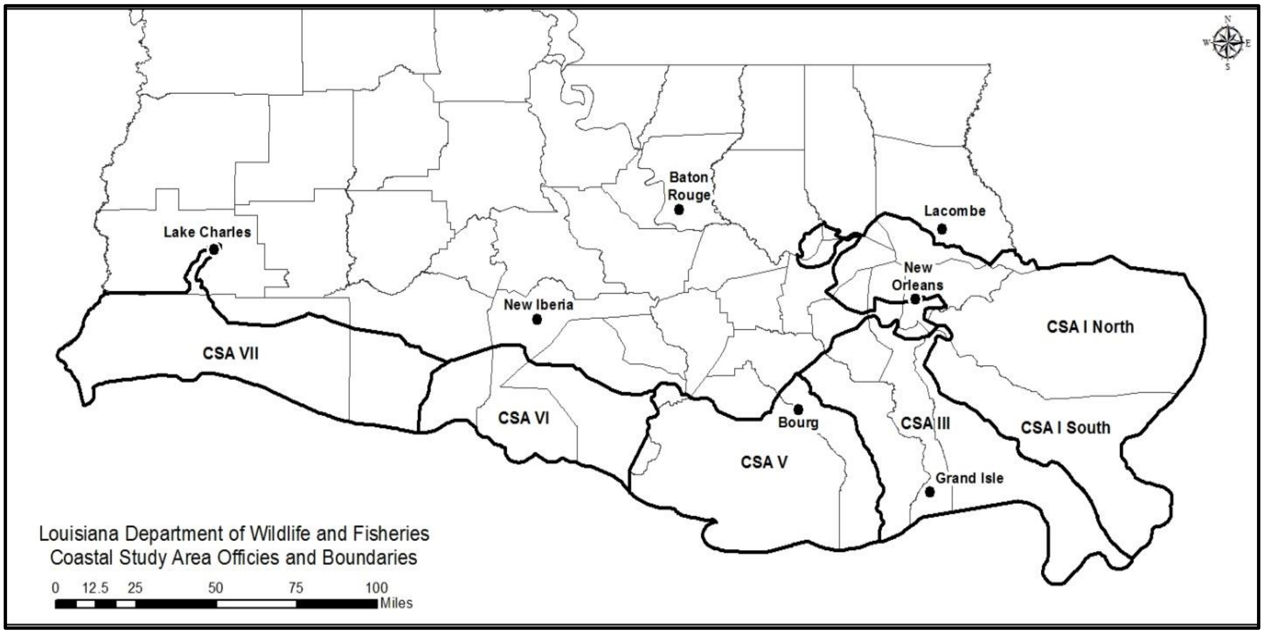


Figure 3. Map of LDWF Fisheries Division Coastal Study Areas (CSAs).

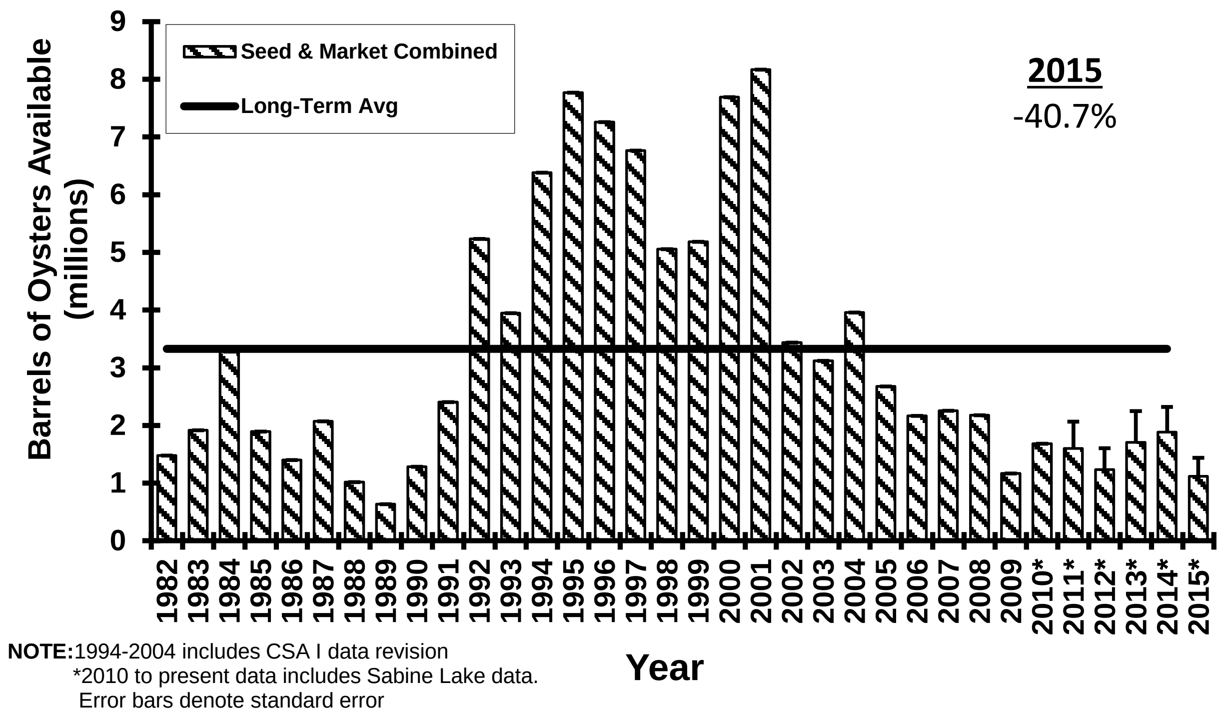


Figure 4. Historical estimated oyster stock size on the public oyster areas of Louisiana. 1994 through 2004 data includes CSA 1N data revision. LTA denotes the long-term average of 1982 - 2014.

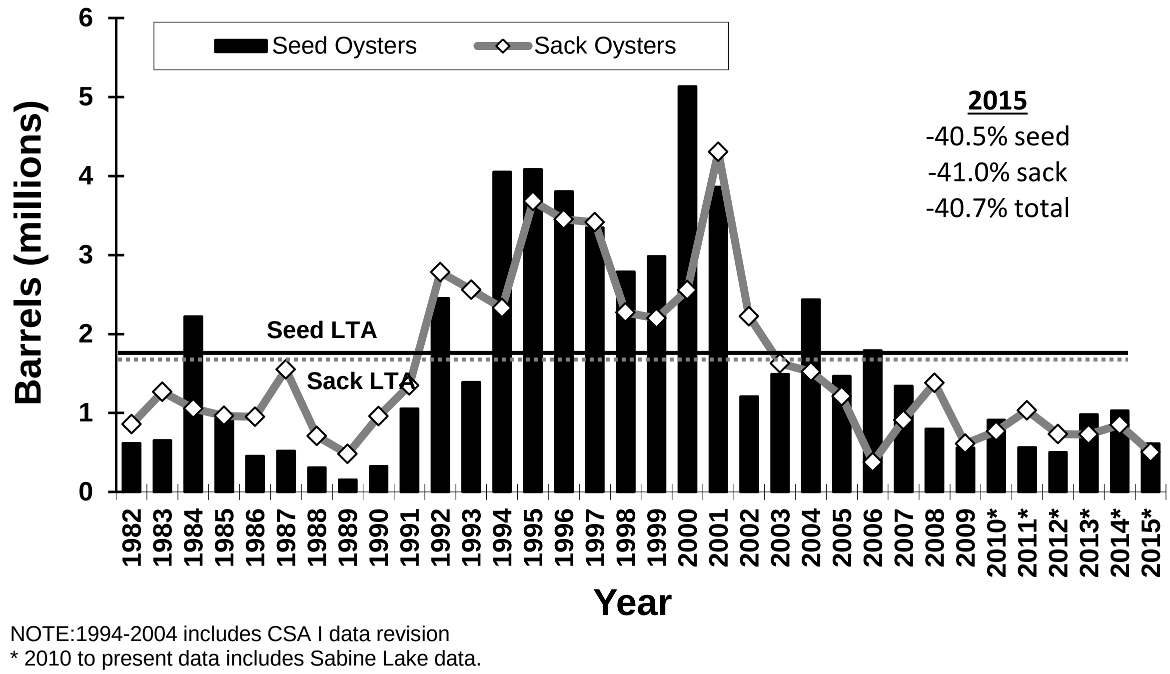


Figure 5. Historical Louisiana oyster stock size on the public oyster areas. LTA denotes the long-term average of 1982 - 2014.

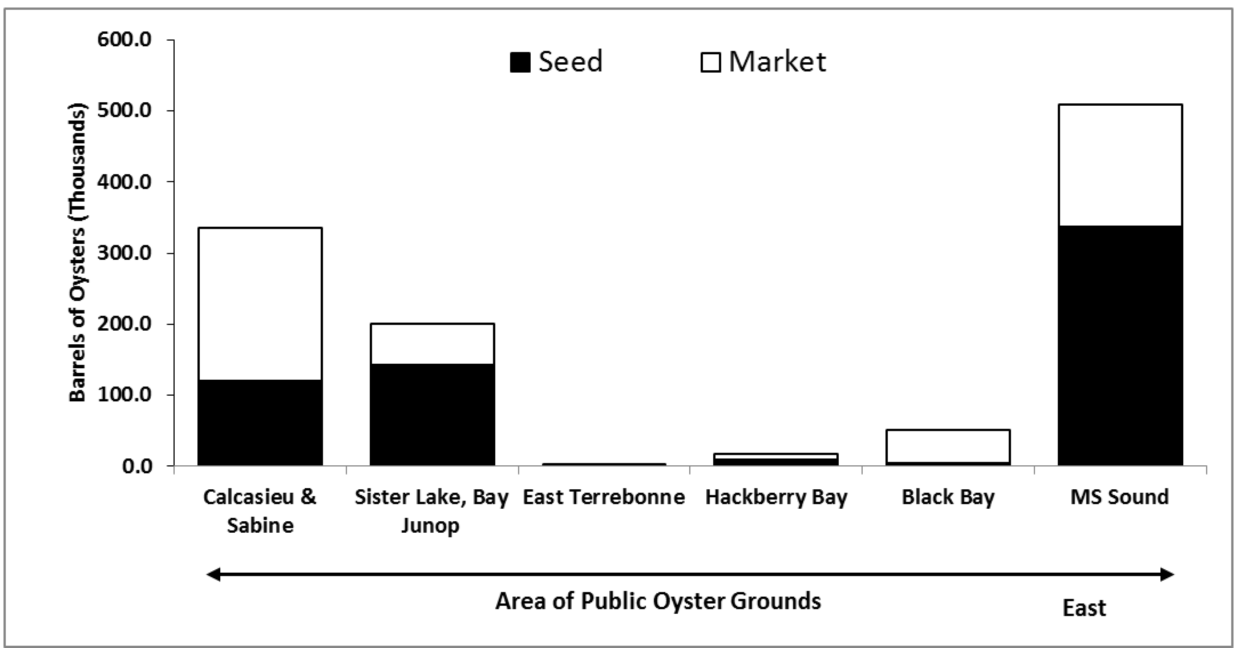
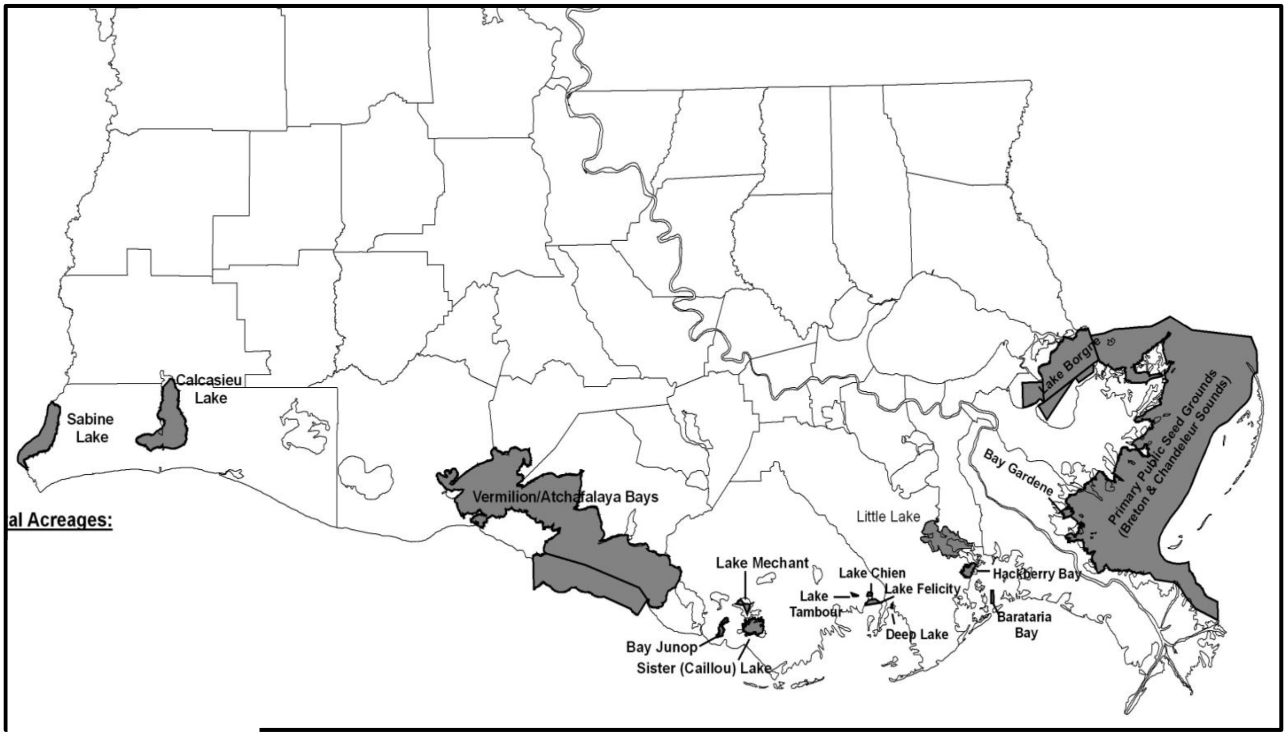


Figure 6. Statewide distribution of oyster stocks in the public oyster areas of Louisiana in 2015.

Public Oyster Areas



Public Seed Grounds*

- Lake Borgne
- Chandeleur/Breton Sound
  (Primary Public Oyster Seed Grounds)
- Barataria Bay
- Little Lake
- Deep Lake
- Lake Chien
- Lake Felicity
- Lake Tambour
- Lake Mechant
- Vermilion/Cote Blanche/Atchafalaya Bays

Public Seed Reservations**

- Bay Gardene
- Hackberry Bay
- Sister (Caillou) Lake
- Bay Junop

Public Oyster Areas**

- Calcasieu Lake
- Sabine Lake

*Seed grounds are designated by the Louisiana Wildlife and Fisheries Commission
**Seed reservations, Calcasieu Lake, and Sabine Lake are designated by the state legislature

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North Pontchartrain Basin (CSA1N) – 2015 Oyster Stock Assessment

Introduction

The Public Oyster Seed Grounds (POSG) in the North Pontchartrain Basin consist of approximately 690,000 water bottom acres located within Lake Borgne, the Louisiana portion of Mississippi Sound, Chandeleur Sound and adjacent waters. These oyster areas are harvested by Louisiana, Mississippi and Texas fisherman, and have historically been areas of high oyster production within the state of Louisiana. Although managed as public oyster seed grounds by the State for many decades before, the majority of this area was not designated as such by Louisiana Wildlife and Fisheries Commission rule until 1988. Much of Lake Borgne was later added as a public oyster seed ground in 1995 and was expanded in 2004. The Department also continually expands and enhances the public oyster reefs through the placement of cultch material (i.e. shell, limestone, crushed concrete) on suitable water bottoms. Most recently cultch plants were completed in Three-Mile Bay (Shell Point) in 2009, Mississippi Sound (Round Island) in 2011, and Three-Mile Pass and Drum Bay in 2013 as part of the oil spill Early Restoration Program.

Currently, these areas are managed to balance the economic opportunity of the fishery with the biological sustainability of the resource. This management is contingent upon obtaining and utilizing the best fishery dependent and independent data available. This includes monitoring the harvest and resource availability throughout the fishing season and performing yearly stock assessments. The information these data provide allow resource managers to implement management changes to both effectively utilize the current resource as well as protect long term viability. This report will fulfill one of those data needs by providing estimates of the current stock size of the oyster resource within this Basin.

Methods

Data for this Oyster Stock Assessment (OSA) was collected between July 06 and July 14, 2015. Divers removed by hand all live and dead oysters, as well as any surficial cultch material from within a one square-meter frame placed directly on the water bottom. Live and dead oysters, spat, fouling organisms, oyster predators were identified and enumerated. Cultch material types collected were identified and weighed. A total of 18 stations were sampled with five square-meter replicates taken at each station (Figure 1.1). The 2011 cultch plant site in Mississippi Sound (Round Island) was sampled utilizing this method for the first time, after being opened to harvest during the 2014-2015 Oyster Season. Likewise, data was collected at the 2013 Early Restoration cultch plant sites, Three-Mile Pass and Drum Bay with the only difference in methodology being that divers used a frame measuring one-quarter (¼) meter square. The average of the replicates was then pooled within reef systems. This average density per reef system was multiplied by the total area of the reef systems. The resulting numbers from these dive samples were adjusted into a barrel unit of measure where one barrel equals 720 seed-sized oysters or 360 market-sized (sack) oysters. Seed oysters are those measuring between 25 and 74 mm with market oysters being greater than 74 mm. Spat oysters are those 24mm and smaller.

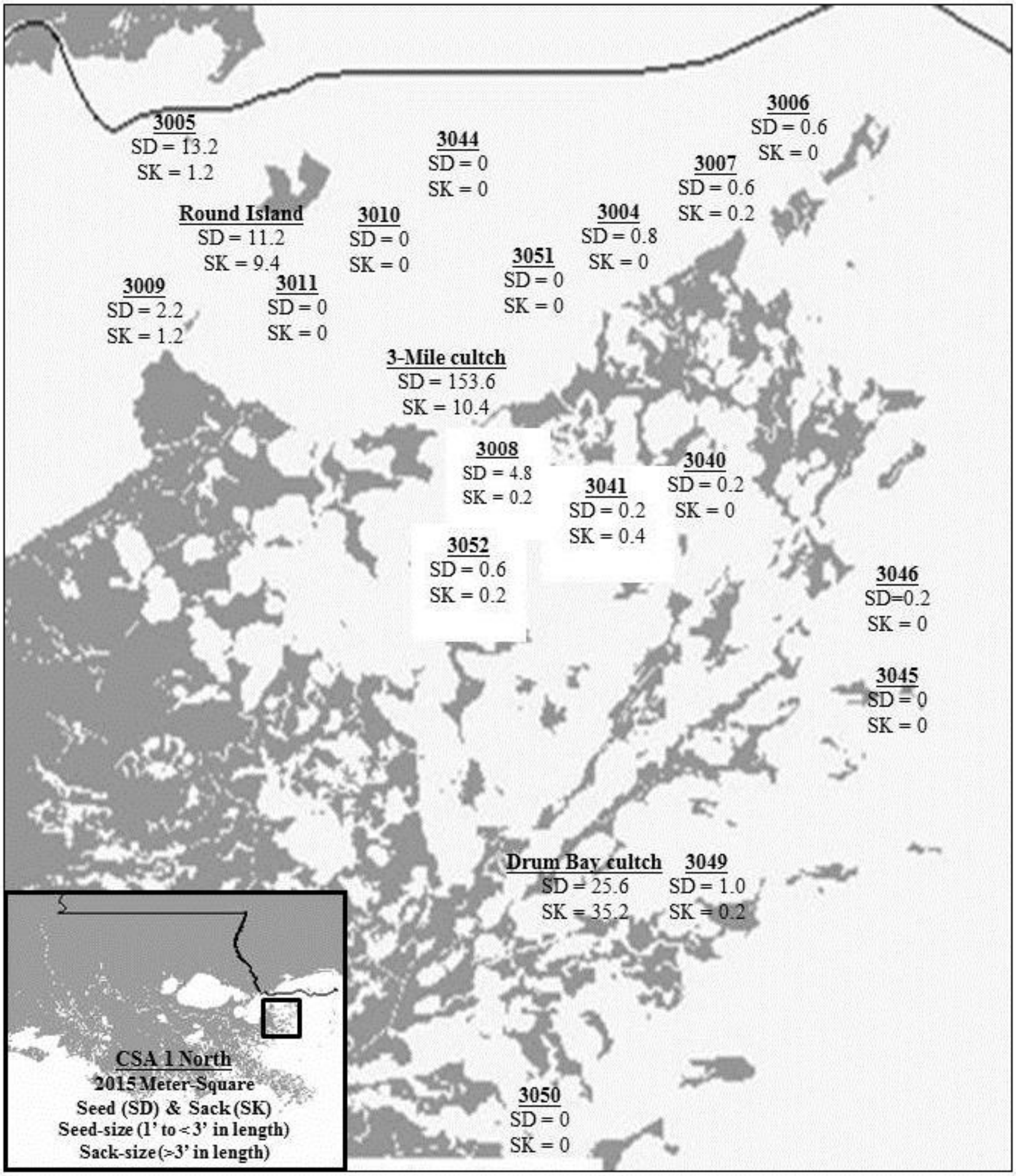

Figure 1.1. Map showing North Pontchartrain Basin oyster stock assessment stations. Numbers below stations are average numbers of seed (SD) and sack (SK) oysters per m^2.

As stated in the previous paragraph, the average density of oyster resource per reef system was multiplied by the total area of the reef system to find the total estimated oyster resource. The amount of assessed reef acreage in years preceding the 2013 Oyster Stock Assessment was estimated at 20,442.48 water bottom acres, based upon water bottom surveys completed in the mid-1970's. In an effort to better locate and assess the oyster resource in the Public Oyster Seed Grounds, a number of side-scan sonar studies of water bottoms in these areas were conducted in recent years. These side-scan studies coupled with historic reef and cultch plant information resulted in a more up-to-date and realistic designation of productive water bottoms for use in the annual Oyster Stock Assessment (Table 1.1).

Table 1.1. Comparison of historical and current reef complex acreages

Change in Reef Acreages			
Station Name	**Station Number**	**Historical Reef Acreage**	**Current Reef Acreage**
Grassy Island	3005	6559.17	5327.98
Halfmoon Island	3010		
Petit Island	3009		
Grand Banks	3044		
Millenium	3011	70	
Three Mile Bay	3008	3058.65	3058.65
East Karako Bay	3040		
West Karako Bay	3041		
Grand Pass	3007	1801.76	5410.97
Cabbage	3006		
Turkey Bayou	3004		
Martin Island	3046	4155.7	3183.26
Holmes Island	3045		
Johnson Bayou	3051	200	200
Drum Bay	3049	1596	1596
Morgan Harbor	3050	2954	2954
Shell Point	3052	47.2	47.2
Round Island	3056	Not Assessed	291
Drum Bay Cultch (2013)		Not Assessed	200
Three Mile Pass Cultch (2013)		Not Assessed	158
	Total	**20,442.48**	**22,427.06**

This 2015 Oyster Stock Assessment, as well as the two previous years' assessments, is based on the updated reef assessment of 22,427.06 water bottom acres, which includes 649 acres of recent cultch plants. As those cultch plants are sampled by a slightly different method and are likely distinctly different from surrounding, existing reef in terms of oyster productivity, the cultch plant acreages are assessed separately and not as part of the surrounding reef complex. It is noted, beginning with the 2013 Oyster Stock Assessment, that the reef acreage for Millennium Reef, in western Mississippi Sound, was added to a reef complex that includes Grassy Island, Halfmoon Island, Petit Island and Grand Banks. Prior to 2013, Millenium Reef's 70 acres had been assessed as a separate reef since its construction in 2000. Side-scan sonar studies revealed that the majority of this reef fell within the Halfmoon Island reef complex and biological sampling indicated that it was no longer distinctively different from surrounding reef acreage. Conversely, the 2011Mississippi Sound cultch plant (Round

Island) was assessed separately from surrounding reef systems. Although this reef was opened to harvest for the first time during the 2014-2015 Oyster Season, it was found to still be significantly different in productivity than those nearby reef systems. It is also noted that only those productive Public Oyster Seed Grounds for which an accurate acreage can be determined are included in the Oyster Stock Assessment. For this reason some areas are not included is this assessment due to a lack of reef acreage information, such as those Public Seed Grounds located within Lake Borgne.

Results and Discussion

Seed and Sack Stock

The current stock size is estimated at 336,732 barrels (bbls) of seed-size oysters and 171,735 bbls of market-size (sack) oysters, for a total of 508,467 bbls of overall stock (Figure 1.2). Compared to 2014, there was a 23.2% decrease in the seed-size estimate and an 11.9% increase in the sack-size estimate. This year's assessed seed stock is 25.7% above the previous ten years' average, while assessed sack stock is 5.3% below the previous ten years' average. This year's sack stock estimate is, however, the highest recorded since 2009. Total assessed oyster stock for 2015 is down 14.0% from 2014, but is 13.2% above the previous ten years' average. It is important to note that this year's seed stock estimate is largely driven by the oyster densities observed on the Three-Mile Pass cultch plant and the Halfmoon Reef Complex, both in Mississippi Sound. The Three-Mile Pass cultch plant accounted for an estimated 136,407 bbls of seed oysters. The Halfmoon Reef Complex, which includes Grassy Island, Halfmoon Island, Petit Island, Grand Banks, and Millennium Reef, was assessed at an estimated 92,236 bbls of seed oysters. These two areas accounted for 40.5% and 27.4% of total assessed seed oyster resource, respectively. The 2015 sack stock estimate was bolstered by the oyster densities found on the Drum Bay cultch plant, which is estimated to hold 79,139 bbls of market-sized oysters, or 46.1% of the total sack stock resource. Oyster density and abundance were not evenly distributed among areas (Table 1.2). The highest density estimates of seed stock were found at the two most recently established cultch plants. Aside from these, Grassy Island and Round Island showed the highest seed oyster densities among harvested reefs. The highest density estimates of sack oysters were found at the Three-Mile Pass cultch plant, the Drum Bay cultch plant, and Round Island sites. Highest overall abundances of seed and sack oysters combined were at the Three-Mile Pass cultch plant, the Drum Bay cultch plant, and the Halfmoon Island reef complex including Grassy Island, Halfmoon Island, Petit Island, Grand Banks and Millennium Reef (Figure 1.1, Table 1.2). One of the most significant observances in this Oyster Stock Assessment could be the estimated 1,789 bbls of seed oysters available at Martin Island. Although not a large amount of resource comparatively, this marks the first oyster measured in a square meter sample from this site since at least the year 2000 assessment.

Table 1.2. Mean densities of oysters collected at each station.

Station	Station Number	Reef Group Acreage	Seed Oysters per m2	Sack Oysters per m2	Number of seed oysters (bbls)	Number of sack oysters (bbls)
Grassy Island	3005	5328.0	13.2	1.2	92,236	28,749
Halfmoon Island	3010		0	0		
Petit Island	3009		2.2	1.2		
Grand Banks	3044		0	0		
Millennium Reef	3011		0	0.0		
Three-Mile Bay	3008	3058.7	4.8	0.2	29,799	6,877
West Karako Bay	3041		0.2	0.4		
East Karako Bay	3040		0.2	0		
Grand Pass	3007	5411.0	0.6	0.2	20,275	4,055
Cabbage Reef	3006		0.6	0		
Turkey Bayou	3004		0.8	0		
Martin Island	3046	3183.3	0.2	0	1,789	0
Holmes Island	3045		0	0		
Shell Point	3052	47.2	0.6	0.2	159	106
Johnson Bayou	3051	200.0	0	0	0	0
Drum Bay	3049	1596.0	1	0.2	8,971	3,588
Morgan Harbor	3050	2954.0	0	0	0	0
Round Island	3056	291.0	11.2	9.4	18,319	30,749
Drum Bay Cultch		200.0	25.6	35.2	28,778	79,139
Three-Mile Pass Cultch		158.0	153.6	10.4	136,407	18,472
2015 Total					**336,732**	**171,735**

It is important to note variability both within and among stations when comparing estimates. This variability is magnified when extrapolating small sample sizes to large areas. In short, changes between annual assessments can be dramatic on an individual reef basis and often only limited areas of large resource availability are identified.

Over the past ten years, the Pontchartrain Basin has experienced heavy localized harvest, high mortality events, strong tropical events such as Hurricanes Katrina in 2005 and Isaac in 2012, the Deepwater Horizon oil spill and related spill response activities and continual limits to recruitment that appear to have severely reduced market-size abundances. As a result, the estimated sack oyster stock continues to be below the previous ten years' average (Figure 1.2). There is, however, observed increase in the 2015 assessed sack stock continuing the trend from last year's stock assessment.

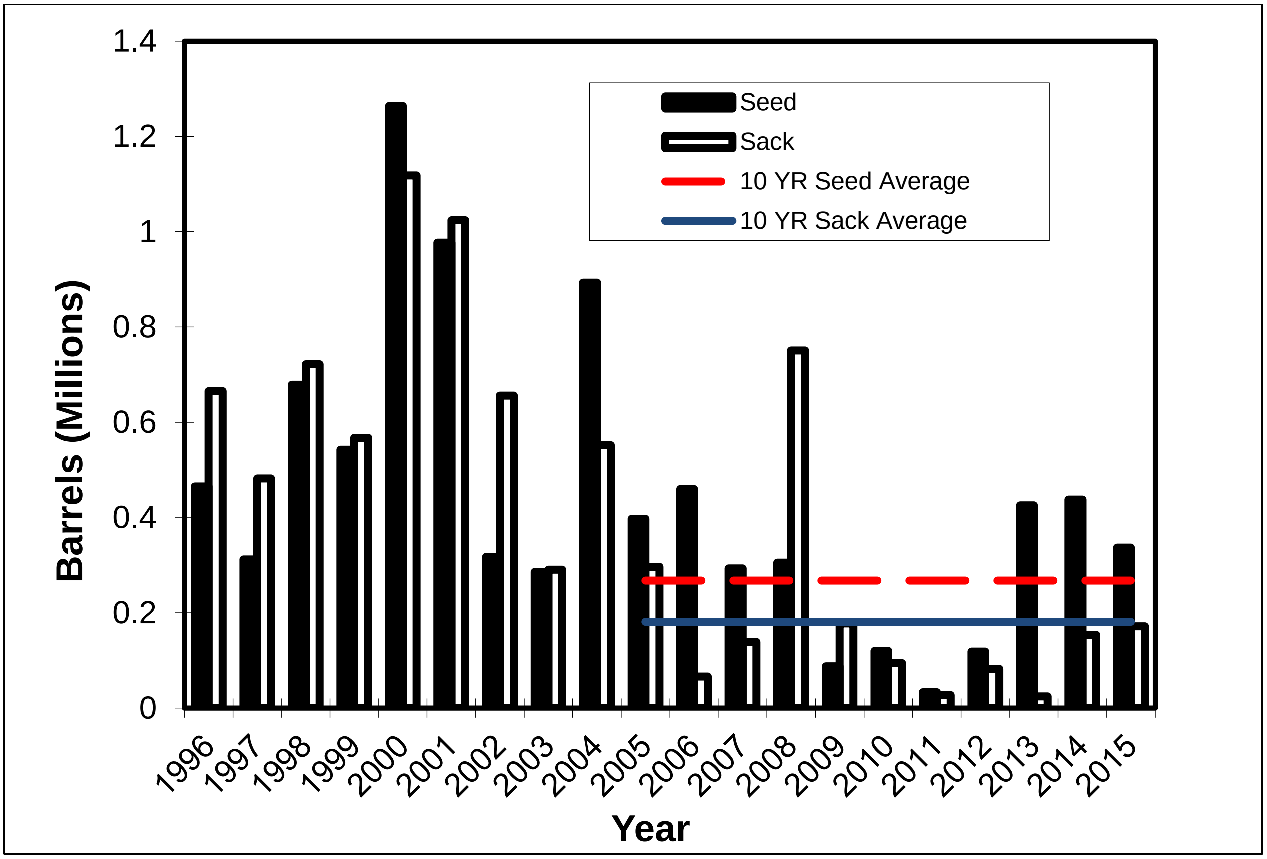

Figure 1.2. Current and historical Stock Assessment (seed and sack oysters) values. Horizontal lines represent the previous ten-years' seed and sack averages.

Spat Production

Live spat were observed at 8 of the 20 sites sampled during this assessment. At these sites, mean densities ranged from 0.2 to 2.4 individuals per m^2 with the maximum value occurring at the Cabbage Reef. Occurrence of spat oysters was up slightly from the previous year's assessment. Overall, spat densities were low with the exception of Cabbage Reef, Round Island, and Drum Bay. Based on previous years' data, annual square-meter samples may occur between seasonal spawning events in some areas. It is important to note that spat numbers are biased by the amount of substrate collected in a given sample. However, this continues an observed lack of spat set over several of the reef areas during the spring spawning events. This could be attributed to several different things or a combination of stressors discussed below.

Fouling Organisms

The hooked mussel, *Ischadium recurvum*, a sessile bivalve that is often times associated with oyster reefs and likely competes with oysters for food and settlement surfaces were observed at 5 of the 20 sample stations. The highest densities of mussels were 6.0/m^2 at Round Island and 5.8/m^2 at the Three-Mile Pass cultch plant. (Table 1.3) Higher mussel densities were generally restricted to western Mississippi Sound. Additional fouling organisms, such as Spionid polychaetes' mud tubes, ctenostomes, and fairy lace bryozoans were not observed at this time on reefs in the northern Pontchartrain Basin.

Table 1.3. Mean density of the hooked mussel, *Ischadium recurvum*, and the southern oyster drill, *Stramonita haemastoma*, at each station.

Station	***I. recurvum* density/(m^2)**	***S. haemastoma* density/(m^2)**
Grassy Island	1.8	0
Petit Island	0	0
Half-moon Island	0.2	0
Grand Banks	0	0.2
Millennium Reef	0	0
Three-mile Bay	0	0
East Karako Bay	0	0
West Karako Bay	0	0
Grand Pass	0	0.2
Turkey Bayou	0	0
Cabbage Reef	0	0.4
Johnson Bayou	0	0
Shell Point	0	0
Drum Bay	0	0
Morgan Harbor	0	0
Martin Island	0	0
Holmes Island	0	0
Round Island	6	0
Drum Bay Cultch	0.2	0
3-Mile Pass Cultch	5.8	0

Oyster Predators and Disease

The southern oyster drill (*Stramonita haemastoma*) is a predatory marine gastropod known to prey on oysters and other sessile animals using a small tooth-like scraping organ called a radula to bore a hole through the oyster shell. During this year's sampling event, oyster drills were observed at 3 sample locations. No oyster drill egg casings were observed. The highest density of oyster drills was at Cabbage Reef, with 0.4/m^2. Grand Pass and Grand Banks had oyster drill densities of 0.2/m^2. Occurrences of oyster drills were limited to sample sites in the northern and eastern portion of Mississippi Sound, where salinities measured at or above 19.0ppt. No stone crabs, *Menippe adinia*, or blue crabs, *Callinectes* spp., were collected in the square meter samples. Other Xanthid crabs were noted in the samples that contained shell for substrate.

Dermo, *Perkinsus marinus*, a protozoan parasite that infects live oyster tissue, is known to cause extensive oyster mortalities especially under high salinity and water temperature conditions. Oyster tissue samples to be tested for presence of this parasite were collected at two sites in North

Pontchartrain Basin, Grand Pass and Three-Mile Bay. Results of the Dermo tests are presented in another section of this report.

Mortality

Mortality estimates are highly variable between size classes and stations during this sampling event (Table 1.4). Spat oyster mortalities show a marked increase compared to last year, with observations made at six sample sites, three of which were recent cultch plants at Round Island, Drum Bay and Three-Mile Pass. Highest observed spat mortalities were at Morgan Harbor and Petit Island, with spat mortality percentages of 100% and 50% respectively. Spat mortalities at other locations ranged from 14.3-37.5%. Seed oyster mortalities were observed at six of the 20 sampled reefs, which was a slight decrease from last year's assessment. Morgan Harbor had a seed mortality of 100% and Drum Bay had a seed mortality of 28.6%. There was sack oyster mortality observed at four locations during the assessment sampling. This was a notable increase from the previous year's assessment, where no sack mortality was observed. Greatest sack mortality was 100%, measured at Millennium Reef. The remaining sack oyster mortalities were found on the recent cultch plants at Round Island, Drum Bay and Three-Mile Pass. It is important to take into consideration that these mortality estimates are often based on an extremely small number of animals. For many of these areas, assessment samples were apparently taken after large mortality events that have either subsided or have severely depleted abundances.

Table 1.4. Mean oyster mortality (recent) estimates from North Pontchartrain Basin m^2 sample stations; N/A = no live or dead oysters were collected for mortality estimates

Station	Spat Mortality (%)	Seed Mortality (%)	Sack Mortality (%)
Grassy Island	0	0	0
Petit Island	50	15.4	0
Halfmoon Island	N/A	N/A	N/A
Grand Banks	N/A	N/A	N/A
Millennium Reef	N/A	N/A	100
Three-Mile Bay	0	0	0
West Karako Bay	N/A	0	0
East Karako Bay	N/A	0	N/A
Shell Point	N/A	0	0
Johnson Bayou	N/A	N/A	N/A
Turkey Bayou	N/A	20	N/A
Cabbage Reef	14.3	0	N/A
Grand Pass	N/A	0	0
Drum Bay	0	28.6	0
Morgan Harbor	100	100	N/A
Martin Island	N/A	0	N/A
Holmes Island	N/A	N/A	N/A
Round Island	33.3	16.4	2.0
Drum Bay Cultch	16.7	0	2.2
3-Mile Pass Cultch	37.5	14.7	12.5

Cumulative Impacts and Mortalities

This section will focus on greater detail concerning environmental conditions observed, as well as direct impacts that have occurred since the previous stock assessment in 2014. It is important to note that many of the topics listed below are correlated with one another, i.e. freshwater inputs-salinity stratification-hypoxia.

Deepwater Horizon Oil Spill and Related Response Actions

The Deepwater Horizon oil spill released millions of barrels of oil into the Gulf of Mexico affecting the Louisiana coastline. In direct response to the oil spill, in an effort to keep incoming oil from the Gulf out of Louisiana's sensitive marshes and estuaries, freshwater was released from diversions and siphons along the Mississippi River. The impacts of oil and freshwater diversions on oyster health and habitat continue to be of concern. Assessments on the direct and indirect impacts of oil and response actions on Louisiana's near shore environment, including oysters and oyster habitat is ongoing.

Tropical and Climatic Events

There were no significant tropical systems impacting the public oyster seed grounds in the Pontchartrain Basin during this assessment period.

Freshets

The Pearl River system had a higher than normal discharge rate in the winter and spring months of 2015, and there were notable decreases in salinities across the North Pontchartrain Basin during the months of January and May (Figures 1.3 and 1.4). The public grounds in western Mississippi Sound were influenced by this higher discharge rate. This is evidenced by salinities being recorded as low as 1.6ppt at Grassy Island and 2.45ppt at Petit Island during the month of June. The salinities at these two reefs were consistently less than 5 parts per thousand (ppt) for the months of May and June 2015. Although these values are discreet measurements, similar low salinity values were also collected by non-related observations, as well as data derived from continuous salinity recorders within the area. While freshets often provide benefits to the reef system, either by reducing disease or predation, or by enhancing cultch opportunities via the shells of recently dead oysters, there are often other cumulative impacts that may affect recovery from any one event. The impacts and subsequent recovery are also modified by not only the magnitude of a freshet, but perhaps also by the duration and timing.

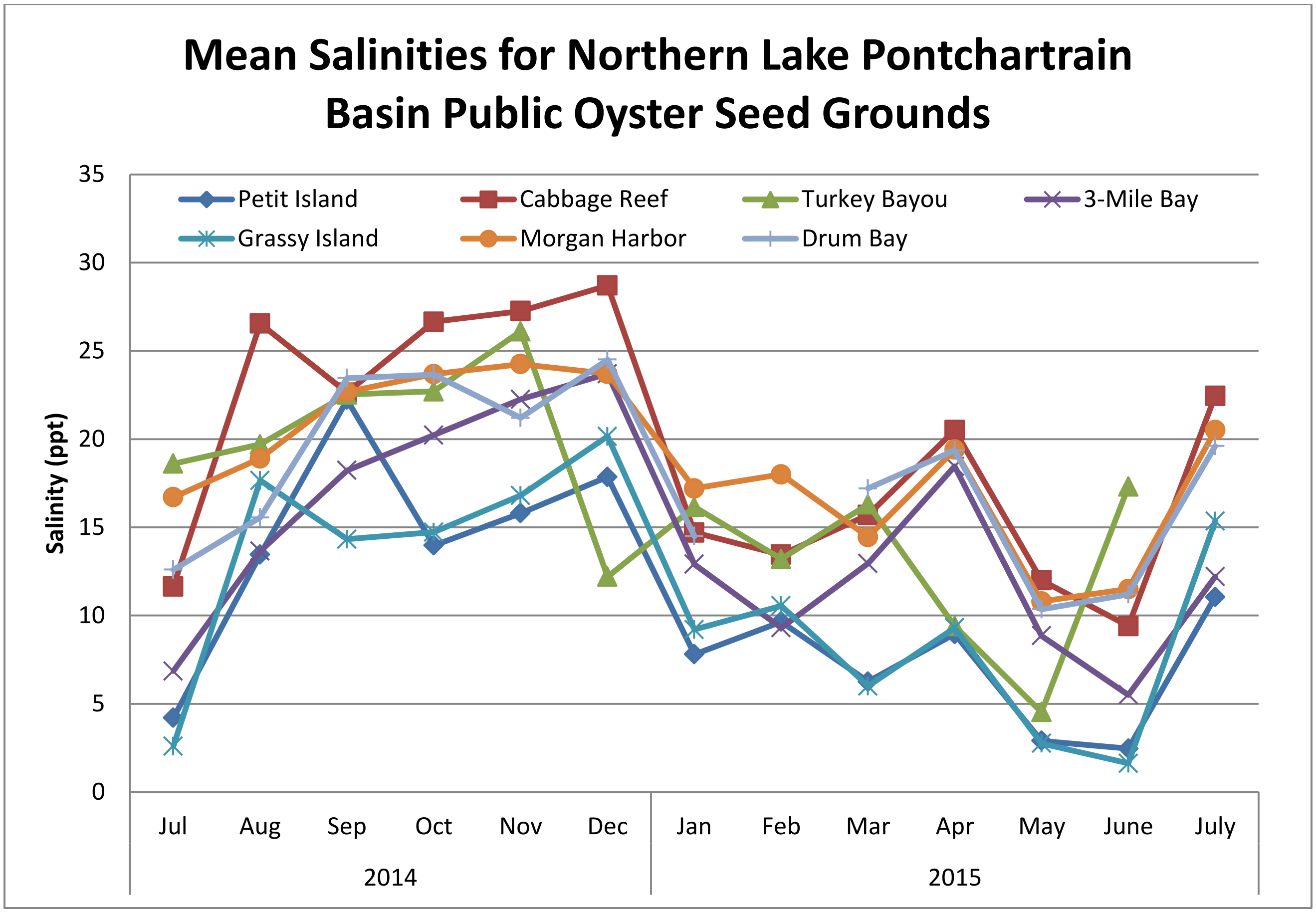

Figure 1.3. Salinities for the Northern Lake Pontchartrain Basin Public Oyster Seed Grounds since 2013 Assessment. Data presented are from discrete measurements on each reef.

Hypoxia

The definition of hypoxia varies as it is based on the percent saturation of water by oxygen. This varies with temperature and amount of other solutes. For most environmental assessments in this area, hypoxia can be viewed as concentrations of dissolved oxygen below 3 milligrams per liter (mg/L). As oysters are a sessile species, reef systems can often be impacted by hypoxia in an estuarine setting. Within the Pontchartrain Basin estuary, the most common driver of hypoxia over reef systems is the stratification of the water column due to density differences in water masses. These density differences are oftentimes driven by salinity and temperature. Basically, warmer, fresher water overrides denser salt water and does not allow the diffusion of oxygen throughout the water column. This is common in areas that have experienced high fresh water inputs, especially after the return of higher salinity waters once fresh water inputs subside. In other cases, in relatively confined areas, increases in biological oxygen demand can also lead to hypoxia, although localized. Some instances of hypoxia are "usual" in most areas, but prolonged exposure can result in reduced growth, decreased disease resistance, or direct mortality. At the time of the 2015 assessment, there was no hypoxia detected on North Pontchartrain Basin reef systems. It is noted that 17 of the 20 sample sites were measured to have bottom dissolved oxygen values between 4.0 and 5.0 mg/L. East Karako Bay was the only site found below this mark at 3.7mg/L.

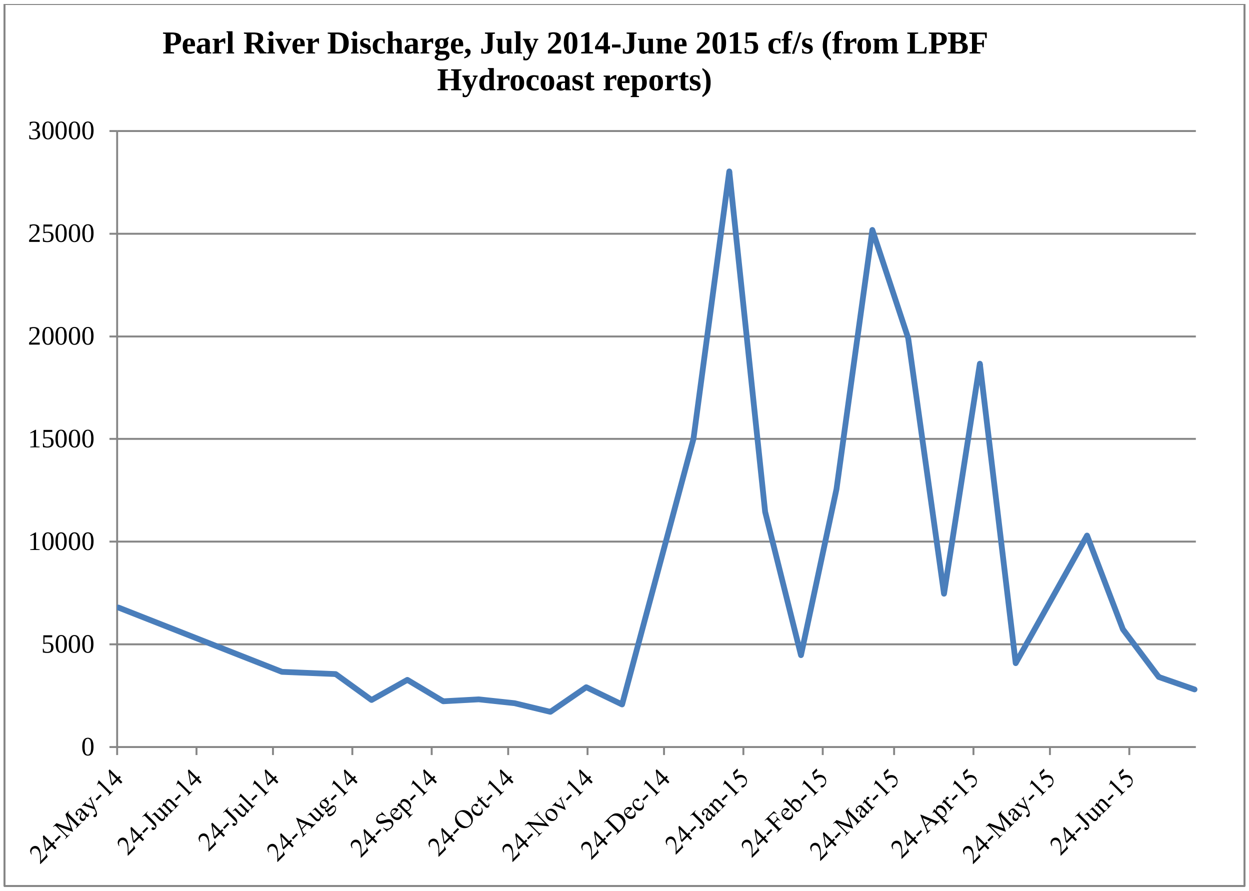

Figure 1.4. Pearl River Discharge in cubic feet / second for months of July 2013 through June 2014. Data are from Hydrocoast Reports prepared by the Lake Pontchartrain Basin Foundation.

Sedimentation/Subsidence

During periods of high freshwater input, sedimentation over reefs can be a problem. This sedimentation can affect the reef either through direct mortality (burial) or through reduced growth and reproduction (both production and clean places for larval attachment). During the 2015 assessment, divers noted on many reefs, especially in the Mississippi Sound and Three-Mile Bay areas, that much of the cultch had a covering of silt or was completely buried. Both of these conditions limit the amount of suitable substrate available for larval settlement.

Subsidence of the reefs is usually balanced by reef accretion or growth. If no appreciable shell is added over a period of time, the reefs, especially those in less than optimal environments, will subside to the point of shell burial. The lowering of the reef profile also subjects associated organisms to more frequent hypoxia events as well as changing the local water flow and sedimentation process.

Cultch Condition

Any successful spat set is dependent upon clean, stable cultch for larval attachment. The condition of the cultch and live oyster shell within the North Pontchartrain Basin continually appears to be poor. As noted above, many areas are buried or covered with a layer of silt. On some reefs, the addition of shell has become so infrequent that the cultch on hand is being transformed into small “hash” particles that may not provide optimal substrate for larval attachment.

2014/2015 Oyster Season Summary

Several tools are used by research personnel to estimate harvest and associated activities by the commercial oyster industry during the harvest season.

Harvest estimates are obtained by monitoring the users and by obtaining fishery dependent data. Fishermen are contacted while fishing and asked to provide estimates of current and past catch and effort, as well as an estimate of future effort. This data is obtained weekly during the oyster season and is used to estimate harvest in a particular reef complex. Harvest data is also obtained via the trip ticket system in place for this fishery. However, trip ticket data is consolidated by geographic region and is considered preliminary until well after the season concludes, and provides a limited resolution.

Fishery independent methods are used to obtain the health and condition of the resource both prior to and during the final stages of the fishing season. Techniques used in these assessments are oyster dredging and visual census. It is important to note that both fishery dependent and independent sources are subject to several large biases and should be used in conjunction to provide a better estimate of the available resource.

The 2014/2015 oyster season within the North Pontchartrain Basin oyster seed grounds was only opened March 16 - 20, 2015 (Figure 1.5). There was a 50 sack-per-day limit on market oysters implemented across the Basin, and the recent cultch plants in Three-Mile Pass and Drum Bay were closed to harvest. The season in this portion of the Basin was delayed in an effort to protect a strong fall spat catch, and to allow those spat oysters to grow into viable sizes before being subjected to commercial dredge activity. Although the season was originally planned to open for 16 days, daily boarding surveys conducted by Area biologists found that some reefs within the Basin could not sustain the observed rate of harvest for that duration.

During this 5-day period, the total harvest estimates for the grounds, as determined by harvest surveys (boarding reports) were 111,434 barrels of seed-sized oysters and 16,372 sacks of market-sized oysters for a combined total of 119,620 barrels of oysters. This represents a 2001% increase over the 2013/2014 harvest of 5,693 bbls. When 2014/2015 harvest estimates within stock-assessed areas are compared with the 2014 stock assessments of areas open to harvest, there was an estimated utilization of 34.45% of the seed resource, 5.35% of the sack resource, and 25.1% utilization overall.

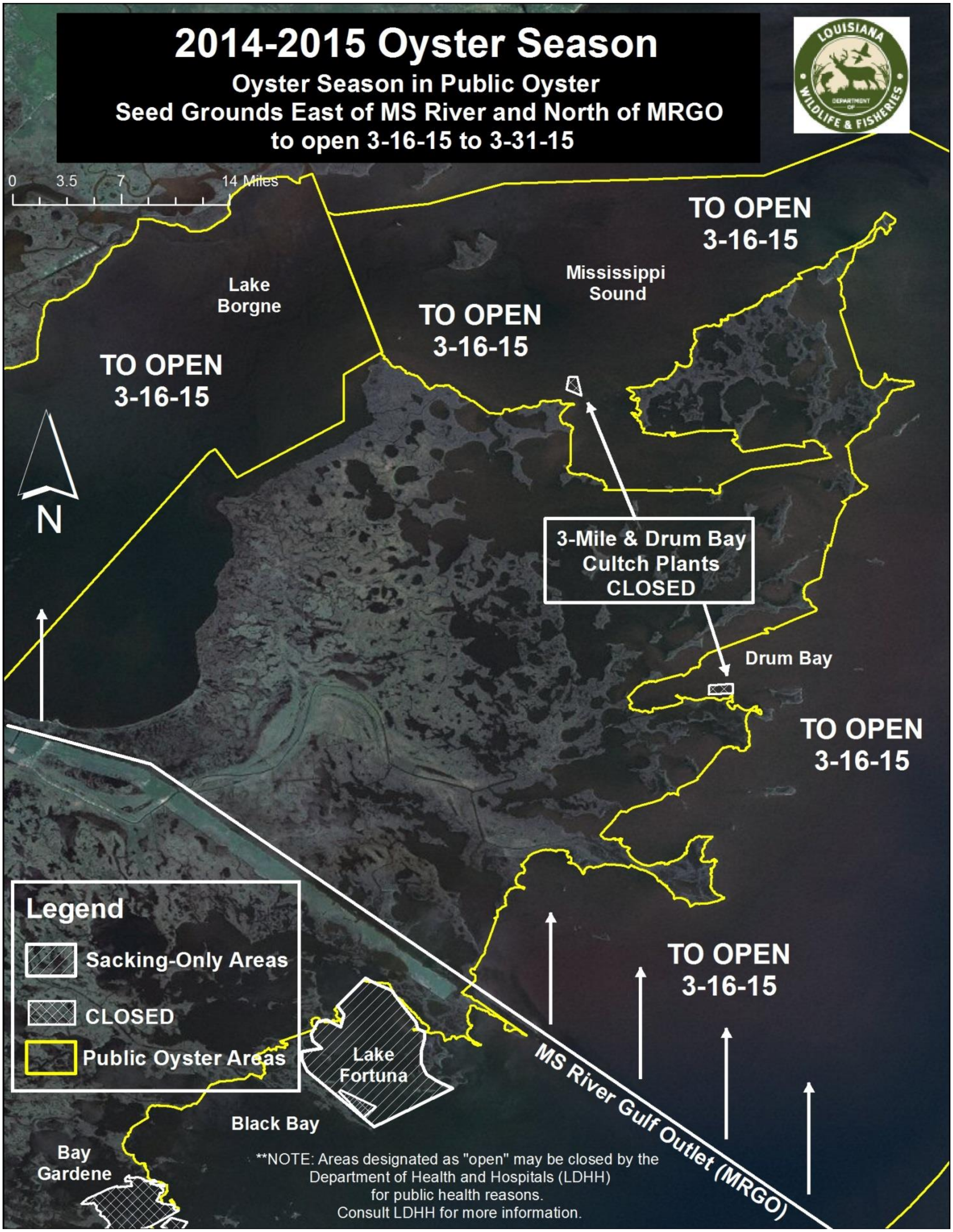

Figure 1.5. Map showing 2014/2015 Oyster season delay on North Pontchartrain Basin Public Oyster Seed Grounds.

In a general spatial context, this harvest was variable throughout the Basin (Table 1.4). The majority of the observed seed harvest was from Round Island, as 71.67% of the total seed harvest occurred on this reef. The majority of market-sized resource was also observed to be harvested from Round Island, which accounted for 69.93% of the combined harvested market-sized oyster resource. Shell Point and Grand Pass also yielded notable harvest of both seed and sack oysters. In all, Round Island produced 79,870 bbls of seed oysters and 11,449 sacks of market oysters, or 85,594.5 bbls of oysters combined. The estimated value of the harvest at this site alone is in excess of $13.9 million.

Table 1.4. Harvest estimates from the 2014/2015 public season within CSA1.

Station	Seed-size (bbls)	Market-size (sacks)
Grassy Island	0	0
Half-moon Island	150	0
Petit Island	0	220
Lake Borgne	0	0
Millennium Reef	4,100	5
Grand Banks	300	0
Three-Mile Bay	0	40
Turkey Bayou	0	0
Johnson Bayou	1,635	2
Grand Pass	10,549	3,248
Cabbage Reef	100	0
West Karako	0	204
East Karako	0	0
Drum Bay	0	100
Morgan Harbor	0	0
Bay Eloi	0	0
Shell Point	14,730	1,104
Round Island	79,870	11,449
Total	**111,434**	**16,372**

While obtaining fishery dependent data, LDWF biologists routinely collect random samples of oyster seed loads from vessels working on the public grounds to determine the percent of cultch (non-living reef material) being harvested. In an effort to more closely monitor harvest rates during the abbreviated season in North Pontchartrain Basin, twenty-five bedding samples were collected. Each sample was collected from a different vessel. Samples came from vessels collecting seed oysters from Round Island, Shell Point, Grand Pass, Millennium Reef and Johnson Bayou. Relative to harvest effort, the majority of bedding material samples were collected from Round Island. Sixteen samples from Round Island had percentages of non-living material ranging from 0.3-15.2%. The percentage of cultch material in three samples taken from Shell Point ranged from 9.3-27.6%. Three samples from Grand Pass yielded non-living cultch material percentages ranging from 19.9-38.8%. The percentages of cultch material in two samples from Millennium Reef were calculated to be 9.7% and 15.9%. A single sample from Johnson Bayou was found to be 4.6% non-living cultch material. Excessive cultch removal from public reef systems by bedding vessels has been a major concern within the Pontchartrain Basin. Compared to recent years' harvests, there was a large decrease in the amount of non-living material observed in bedding loads during the 2014/2015 Oyster season in the North Pontchartrain Basin.

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South Pontchartrain Basin (CSA1S) – 2015 Oyster Stock Assessment

Introduction

The public oyster seed grounds in the South Pontchartrain Basin (formerly Coastal Study Area 2) consist of approximately 300,000 water bottom acres located from the Mississippi River Gulf Outlet (MRGO) southward to South Pass in the Mississippi River delta, and eastward from the eastern extent of private leases east of the Mississippi River to the Breton National Wildlife Refuge. These seed grounds include Bay Gardene Public Oyster Seed Reservation, as well as areas designated as "sack harvest only" in Lake Fortuna, Lake Machias, and Bay Long. Historically, this area has provided seed- and market-sized oysters for oyster fishermen from Louisiana, Mississippi and Texas. Hydrology in the area is influenced at high Mississippi River stages by discharge through gaps in the Mississippi River levee south of Pointe a la Hache, such as the Bohemia spillway and Mardi Gras Pass; discharge from the Caernarvon and Bayou Lamoque fresh water diversion structures; and main-stem river distributaries in the southern portion of the Basin.

The Department of Wildlife and Fisheries continually expands and enhances the public oyster reefs through the placement of cultch material (i.e. shell, limestone, crushed concrete) on suitable water bottoms. Numerous cultch plants have been constructed throughout this Basin since 1917, including sites in Bay Gardene and Black Bay. Most recently cultch plants were completed in California Bay in 2011, as well as in Bay Crabe and Lake Fortuna in 2012 as part of the Deepwater Horizon oil spill Early Restoration Program.

Currently, this area is managed to balance the economic opportunity of the fishery with the biological sustainability of the resource. This management is contingent upon obtaining and utilizing the best fishery dependent and independent data available. This includes monitoring the harvest and resource availability throughout the fishing season and performing yearly stock assessments. The information these data provide allow resource managers to implement management changes to both effectively utilize the current resource as well as protect long term viability. This report will fulfill one of those data needs by providing estimates of the current stock size of the oyster resource within this Basin.

Methods

Data was collected between July 01 and July 14, 2015. Divers removed by hand all live and dead oysters, as well as any surficial cultch material from within a one square-meter frame randomly placed on the water bottom. Live and dead oysters, spat, fouling organisms, and oyster predators were identified and enumerated. A total of 30 historic stations were sampled with five square-meter replicates taken at each station (Figure 2.1). The average of the replicates was then pooled within reef systems. This average density per reef system was multiplied by the total area of the reef systems. Likewise, data was collected at the Early Restoration cultch plants in Bay

Crabe and Lake Fortuna, with the only difference in method being that divers used a frame measuring ¼ meter square. The resulting numbers were adjusted into a barrel unit of measure where one barrel equals 720 seed-sized oysters or 360 market-sized (sack) oysters. Seed oysters are those measuring between 25 and 74 mm with market oysters being greater than 74 mm. Spat oysters are those 24mm and less.

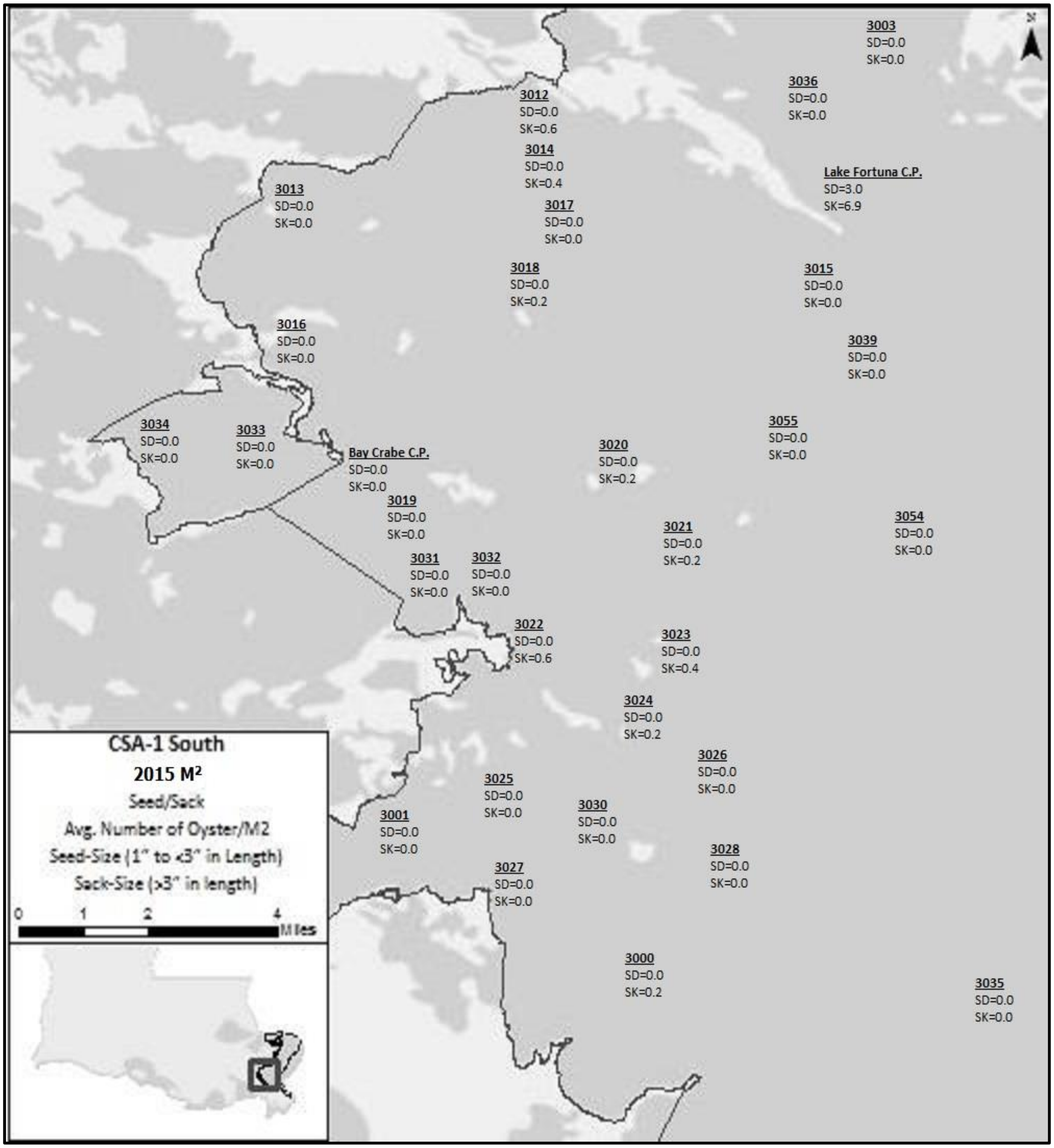

Figure 2.1. Map showing stock assessment sample stations within Coastal Study Area 1-South. Station numbers are in bold and data below indicate the average number of seed (SD) and sack (SK) oysters collected per sample at that station.

Prior to 2013, stock assessments for the South Pontchartrain Basin had been based upon an acreage value of 16,644 acres, as was determined by water bottom surveys completed in the mid-1970s. In an effort to better locate and assess the oyster resource in the public oyster seed grounds, a number of side-scan sonar studies of water bottoms in the South Pontchartrain Basin have been conducted in recent years. These side-scan studies coupled with historic reef and cultch plant information have resulted in a more up-to-date and realistic designation of productive water bottoms for use in the annual Oyster Stock Assessment (Table 2.1).

Table 2.1. Comparison of historical and current reef complex acreages

Complex Name	Station Name	Station Number	Old Number	Historic Acreage	Current Acreage
East Black Bay	Jessies Island	3013	2	59.00	
	Bayou Lost	3016	5	118.00	549.89
Bay Gardene	Bay Gardene	3034	24	69.00	
	East Bay Gardene	3033	23	28.00	1,262.64
Bay Crabe	West Bay Crabe	3019	8	501.00	
	Bay Crabe	3031	21	659.00	
	East Bay Crabe	3032	22	122.00	1,531.96
Elephant Pass	Elephant Pass	3022	11	339.00	202.21
California Bay	Sunrise Point	3027	16	174.00	
	California Bay	3025	14	7.00	
	West Pelican Island	3030	20	293.00	
	Bay Long	3001	17	572.00	3,692.78
Mangrove	Mangrove	3000	19	937.00	
	East Pelican	3028	18	782.00	2,889.11
South Black Bay	Stone Island	3020	9	461.00	
	South Black Bay	3021	10	145.00	
	Curfew Island	3023	12	425.00	
	North California Bay	3024	13	109.00	
	Telegraph Island	3026	15	127.00	3,575.74
Lonesome Island	Snake Island	3012	1	506.00	
	North Lonesome Island	3014	3	896.00	
	Lonesome Island	3017	6	716.00	
	Black Bay	3018	7	301.00	2,861.94
Lake Fortuna	Lake Fortuna South	3036	27	2,144.00	
	Lake Fortuna North	3003	30	2,144.00	3,453.85
Horseshoe Reef	North Black Bay	3015	4	157.50	
	Horseshoe Reef	3039	26	157.50	
	East Stone Island	3055	29	1,138.00	2,485.81
Wreck	Wreck	3054	28	1,138.00	4,485.79
Battledore Reef	Battledore Reef	3035	25	1,419.00	270.57
Bay Crabe CP (2012)					200.00
Lake Fortuna CP (2012)					300.00
			Total	16,644.00	**27,762.29**

The 2015 Oyster Stock Assessment, as well as the two previous year's assessments, is based on the updated reef acreage of 27,262.29 water bottom acres. This stock assessment further includes

500 acres of recent cultch plants. As those cultch plants are sampled by a slightly different method and are likely distinctly different from surrounding, existing reef in terms of oyster productivity, the cultch plant acreages are assessed separately and not as part of the surrounding reef system. Since its construction in 2011, the California Bay cultch plant had been assessed as a separate reef. Biological sampling at this site has indicated that it is no longer distinctively different from surrounding reef acreage. As a result, in this Oyster Stock Assessment, that cultch plant acreage (300 acres) is being assessed along with the surrounding California Bay Reef Complex, which includes Bay Long, Sunrise Point, West Pelican Island, and California Bay sample sites.

Beginning with the 2013 Oyster Stock Assessment, oyster reefs within the South Pontchartrain Basin were grouped into reef complexes. Prior to this time, each reef was represented by one of thirty square-meter sample stations. The reefs placed within a reef complex were those closely related in regards to location, hydrology, oyster productivity, and response to environmental stressors. A total of twelve reef complexes were designated, each with 1 to 5 representative square-meter sample stations (Figure 2.2). An additional 1,524 acres of oyster habitat (reef and scattered shell) was identified by the recent water bottom assessments, but is not included in the annual stock assessment acreage, as it was felt that no current oyster sampling station adequately described this acreage.

Figure 2.2. Reef complex designations in Coastal Study Area 1-South based on recent water bottom assessments (side-scan sonar).

Results and Discussion

Seed and Sack Stock

The current stock size for the South Pontchartrain Basin is estimated at 5,058.59 barrels (bbls) of seed oysters and 45,571.92 bbls of market sized oysters for a total of 50,630.51 bbls of overall stock. These numbers are based upon assessed reef acreage of 27,762.29 water bottom acres, including 500 acres of recent cultch plants. Compared to 2014, there was an 82.82% decrease in the seed-size estimate and an 18.61% decrease in the sack-size estimate. Overall abundance decreased 40.74% from last year's Oyster Stock Assessment. Overall oyster stock for the South Pontchartrain Basin is down 87.07% from the previous 10 years' average, and down 96.33% from the long term average (1982-2014) (Figure 2.3). The seed oyster stock estimate is down 98.15% from the previous 10 years' average, and down 99.39% from the long term average (1982-2014). The 2015 sack stock estimate is 61.26% below the previous ten years' average, and 91.06% less than the long-term average (1982-2014).

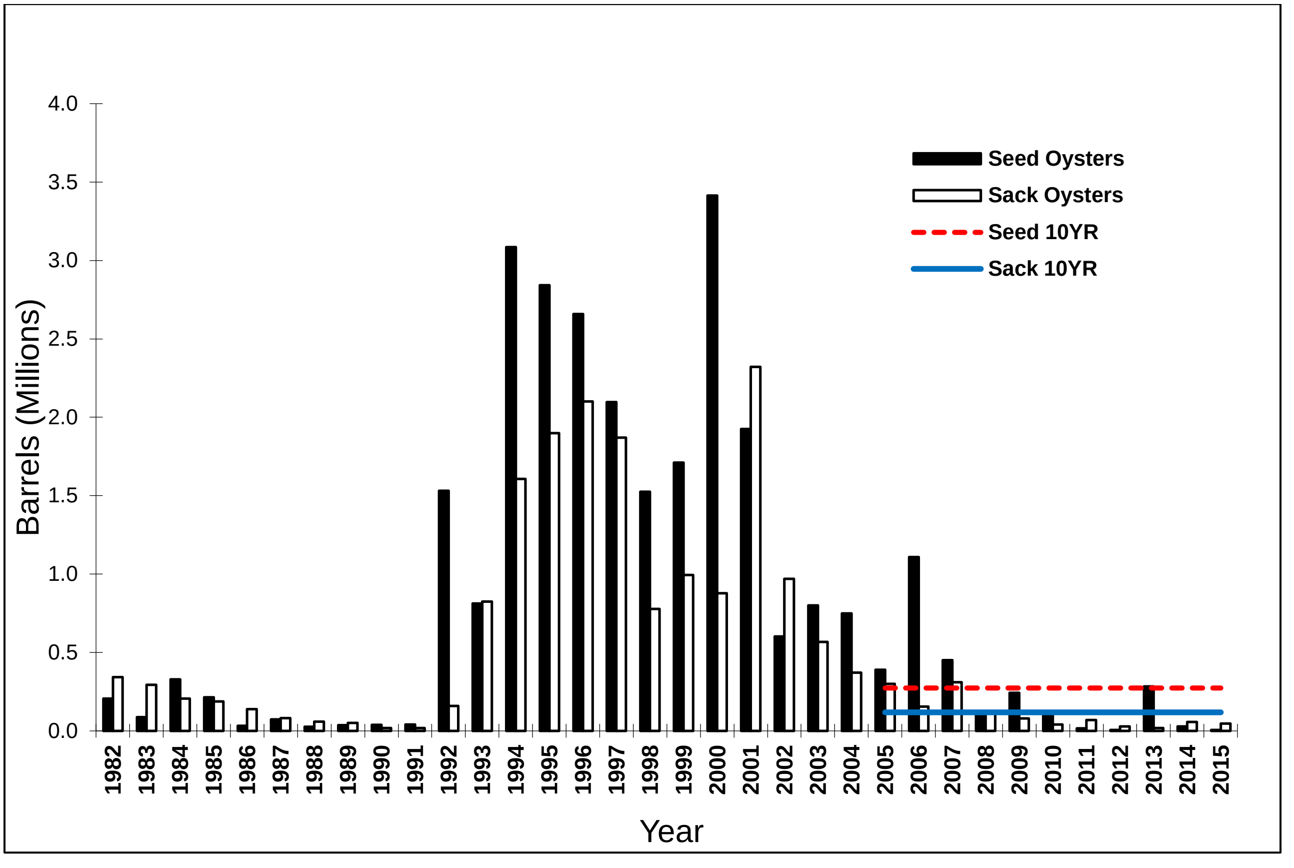

Figure 2.3. Current and historical stock assessment (seed and sack oysters) values.

Oyster density and abundance was clearly not distributed evenly among sample sites (Figure 2.1, Table 2.2). Alarmingly, only four of the twelve reef complexes and one recent cultch plant were estimated to have any oyster resource. Even more startling was the lack of observation of seed oyster stock on any of the twelve reef complexes. Only the 2012 Lake Fortuna cultch plant was observed to hold seed oysters. The highest total abundance and the highest average density of sack-sized oysters were also found at the Lake Fortuna cultch plant. Approximately 51.1% of estimated available sack oyster stock was found to be in this area. The highest average densities of sack-sized oysters among harvested reefs were located at Elephant Pass and Snake Island, with 0.6 market oysters per square-meter. The highest total abundances of sack stock among harvested reefs were found at the Lonesome Island and South Black Bay reef complexes. These accounted for 9,651.59 bbls and 8,039.20 bbls of sack-sized oysters, respectively.

Table 2.2. Mean densities of oysters collected at each station.

Station Name	Station Number	Mean densities			Barrels of seed oysters	Barrels of sack oysters
		spat	seed	sack		
Jessies Island	3013	0	0	0	0	0
Bayou Lost	3016	0	0	0		
Bay Gardene	3034	0	0	0	0	0
East Bay Gardene	3033	0	0	0		
West Bay Crabe	3019	0	0	0	0	0
Bay Crabe	3031	0	0	0		
East Bay Crabe	3032	0	0	0		
Elephant Pass	3022	0	0	0.6	0	1,363.86
Sunrise Point	3027	0	0	0	0.00	0.00
California Bay	3025	0	0	0		
West Pelican Island	3030	0	0	0		
Bay Long	3001	0	0	0		
Mangrove	3000	0	0	0.2	0	3,247.74
East Pelican	3028	0	0	0		
Stone Island	3020	0	0	0.2	0.00	8,039.20
South Black Bay	3021	0	0	0.2		
Curfew Island	3023	0	0	0.4		
North California Bay	3024	0	0	0.2		
Telegraph Island	3026	0	0	0		
Snake Island	3012	0	0	0.6	0.00	9,651.59
North Lonesome Island	3014	0	0	0.4		
Lonesome Island	3017	0	0	0		
Black Bay	3018	0	0	0.2		
Lake Fortuna South	3036	0	0	0	0.00	0.00
Lake Fortuna North	3003	0	0	0		
North Black Bay	3015	0	0	0	0	0
Horseshoe Reef	3039	0	0	0		
East Stone Island	3055	0	0	0		
Wreck	3054	0	0	0	0	0
Battledore Reef	3035	0	0	0	0	0
Bay Crabe CP (2012)		0	0	0	0	0
Lake Fortuna CP (2012)		0	**3**	**6.9**	**5,058.59**	**23,269.50**
2015 Total					**5,058.59**	**45,571.89**

Over the past ten years, the South Pontchartrain Basin has experienced heavy localized harvest, high mortality events, strong tropical events such as Hurricanes Katrina in 2005 and Isaac in 2012, the Deepwater Horizon oil spill and related spill response activities, and increasing freshwater influence from the Mississippi River. All of these appear to have severely reduced oyster abundances. As a result, the estimated oyster stock continues to be far below both the previous ten years' average and the long-term (1982-2014) average (Figure 2.3).

Mortality
No recent oyster mortalities were observed during this assessment. Under normal conditions, this could be interpreted as a sign of a healthy population with only minimal impacts from disease or predators. In this instance, however, it could be attributed to samplers finding oyster resource at only 10 of the 32 sites sampled.

Spat Production
No live spat were sampled during this assessment. Although these assessment events may occur outside of the peak spawning period, it is evident that there has been only minimal spat catch on these reefs. This marks a continuation of poor spat catches within this Basin. This may be attributed to several causes discussed below.

Fouling Organisms
Hooked mussels (*Ischadium recurvum*) are a sessile bivalve that is oftentimes associated with oyster reefs and compete with oysters for food and settlement surfaces. During this assessment hooked mussels were present at 25 of the 32 stations sampled and ranged in density from 0.2 to 2,622.7 individuals / m^2 (Table 2.3). Overall, hooked mussel density has decreased over the previous assessment with the largest decrease in density observed at the West Pelican Island and Bay Long sample sites. Decreases in hooked mussel density were observed at twenty-one of the 32 stations. There were however notable large increases in hooked mussel densities at East Bay Gardene and the Lake Fortuna cultch plant. Additionally, Spionid polychaete mud tubes, ctenostome and fairy lace bryozoans, and other small hydroids continue to be found on live oysters and the exposed shell in the assessment area, though not as prevalent as in the previous three years' Oyster Stock Assessments. Also noted by samplers, was moderate to heavy barnacle fouling of oyster shells at sites throughout the Basin. All of these forms of fouling appear to be a contributing factor to the limited attachment of oyster larvae to available substrate.

Oyster Predators/Disease
The southern oyster drill (*Stramonita haemastoma*) is a predatory marine gastropod known to prey on oysters and other sessile animals using a small tooth-like scraping organ called a radula to bore a hole through the oyster shell. Snails were found at only the South Black Bay sample site. Recent extended periods of low salinity may have limited snail abundance in the area. No

stone crabs (*Mennipe adinia*), and one blue crab (*Callinectes sapidus*) were observed in the samples.

Perkinsus marinus (= Dermo), a protozoan parasite that infects oyster tissue, is known to cause extensive oyster mortalities especially under high salinity and high water temperature conditions. Dermo samples were attempted at 7 stations throughout the area. Results of the Dermo tests are presented in another section of this report.

<u>Cumulative Impacts and Mortalities</u>

This section will focus on greater detail concerning environmental conditions observed, as well as direct impacts that have occurred since the previous stock assessment in 2014. It is important to note that many of the topics listed below are correlated with one another, i.e. freshwater inputs-salinity stratification-hypoxia.

Deepwater Horizon Oil Spill and Related Response Actions

The Deepwater Horizon oil spill released millions of barrels of oil into the Gulf of Mexico affecting the Louisiana coastline. In direct response to the oil spill, in an effort to keep incoming oil from the Gulf out of Louisiana's sensitive marshes and estuaries, freshwater was released from diversions and siphons along the Mississippi River. The impacts of oil and freshwater diversions on oyster health and habitat continue to be of concern. Assessments on the direct and indirect impacts of oil and response actions on Louisiana's near shore environment, including oysters and oyster habitat is ongoing.

Tropical and Climatic Events

There were no significant tropical systems impacting the public oyster seed grounds in the Pontchartrain Basin during this assessment period.

Table 2.3. Mean density of the hooked mussel, *Ischadium recurvum*, and the southern oyster drill, *Stramonita haemastoma*, at each m^2 station.

Complex Name	Station Name	Station Number	*I. recurvum* density/(m^2)	*S. haemastoma* density/(m^2)
East Black Bay	Jessies Island	3013	0.2	0
	Bayou Lost	3016	0	0
Bay Gardene	Bay Gardene	3034	320	0
	East Bay Gardene	3033	2485.6	0
Bay Crabe	West Bay Crabe	3019	0	0
	Bay Crabe	3031	0	0
	East Bay Crabe	3032	37.2	0
Elephant Pass	Elephant Pass	3022	200	0
California Bay	Sunrise Point	3027	27.1	0
	California Bay	3025	20.2	0
	West Pelican Island	3030	0	0
	Bay Long	3001	167	0
Mangrove	Mangrove	3000	103.6	0
	East Pelican	3028	54.2	0
South Black Bay	Stone Island	3020	199.6	0
	South Black Bay	3021	93	0.2
	Curfew Island	3023	276.6	0
	North California Bay	3024	106.6	0
	Telegraph Island	3026	52.4	0
Lonesome Island	Snake Island	3012	304.6	0
	North Lonesome Island	3014	397.8	0
	Lonesome Island	3017	30.4	0
	Black Bay	3018	529.6	0
Lake Fortuna	Lake Fortuna South	3036	0	0
	Lake Fortuna North	3003	0	0
Horseshoe Reef	North Black Bay	3015	0	0
	Horseshoe Reef	3039	12.4	0
	East Stone Island	3055	160	0
Wreck	Wreck	3054	134.4	0
Battledore Reef	Battledore Reef	3035	0.5	0
Bay Crabe CP (2012)			318.4	0
Lake Fortuna CP (2012)			2622.7	0

Freshets

While freshets often provide benefits to the reef system, either by reducing disease or predation, or enhancing cultch opportunities via empty shells of recently-dead oysters, we must also realize that other variables are also operating at the same time. The impact and recovery from freshets can be modified by not only the magnitude of the freshet, but perhaps more importantly by the duration and timing of the freshet. Specifically, this area experienced such an event during this assessment period, which occurred during, or very near, peak spawning times in the spring and early summer of 2015. Although, salinities across the Basin were consistently at or above 10 parts per thousand (ppt) throughout most of the assessment year (Figure 2.4), there was a notable decrease in salinity across a majority of the Basin between the months of May and June 2015. During this period, salinities at Mangrove and East Bay Gardene fell to 0.6 and 1.85ppt respectively. South Black Bay and East Bay Crabe both had salinities below 4.0ppt during this same time period.

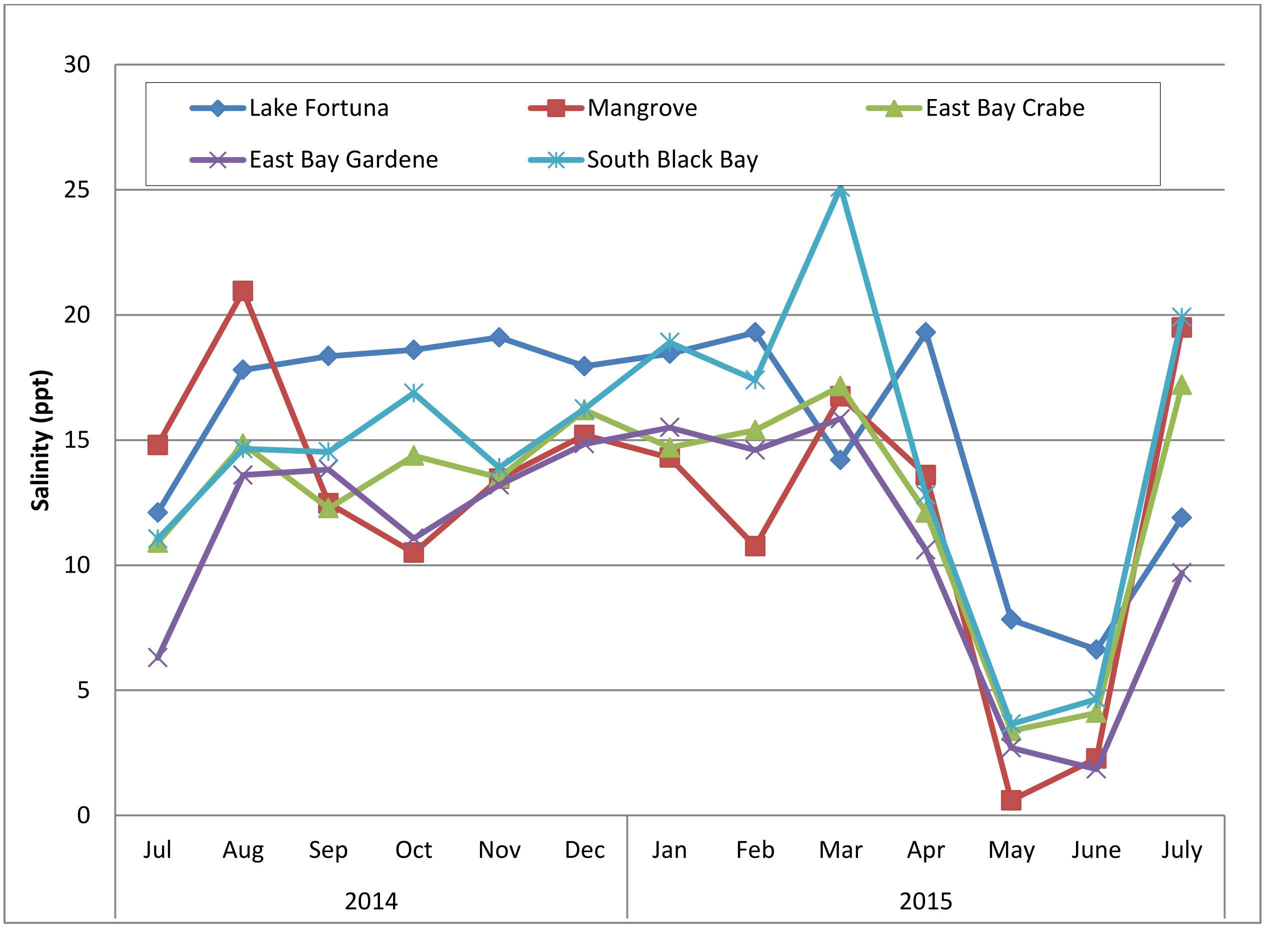

Figure 2.4. Salinities (ppt) for the South Pontchartrain Basin Public Oyster Seed Grounds since 2014 Assessment. Data presented are from discrete measurements on each reef during monthly oyster sampling events.

Hypoxia

The definition of hypoxia varies as it is based on the percent saturation of water by oxygen. This varies with temperature and amount of other solutes. For most environmental assessments in this area, hypoxia can be viewed as concentrations of dissolved oxygen below 3 milligrams per Liter (mg/L). As oysters are a sessile species, reef systems can often be impacted by hypoxia in an estuarine setting. Within the Pontchartrain Basin estuary, the most common driver of hypoxia over reef systems is the stratification of the water column due to density differences in water masses. These density differences are oftentimes driven by salinity and temperature. Basically, warmer, fresher water overrides denser salt water and does not allow the diffusion of oxygen throughout the water column. This is common in areas that have experienced high fresh water inputs, especially after the return of higher salinity waters once fresh water inputs subside. In other cases, in relatively confined areas, increases in biological oxygen demand can also lead to hypoxia, although localized. Some instances of hypoxia are "usual" in most areas, but prolonged exposure can result in reduced growth, decreased disease resistance, or direct mortality. At the time of the 2014 assessment, only the Mangrove Point area was experiencing a period of hypoxia as was evidenced by dissolved oxygen measurements of 3.55 mg/L. The remainder of the public grounds, by in large, has had adequate oxygen saturation during this assessment period (Figure 2.5). It is noted that there was a short-lived hypoxic event that was observed across the majority of the Basin during the month of September 2014.

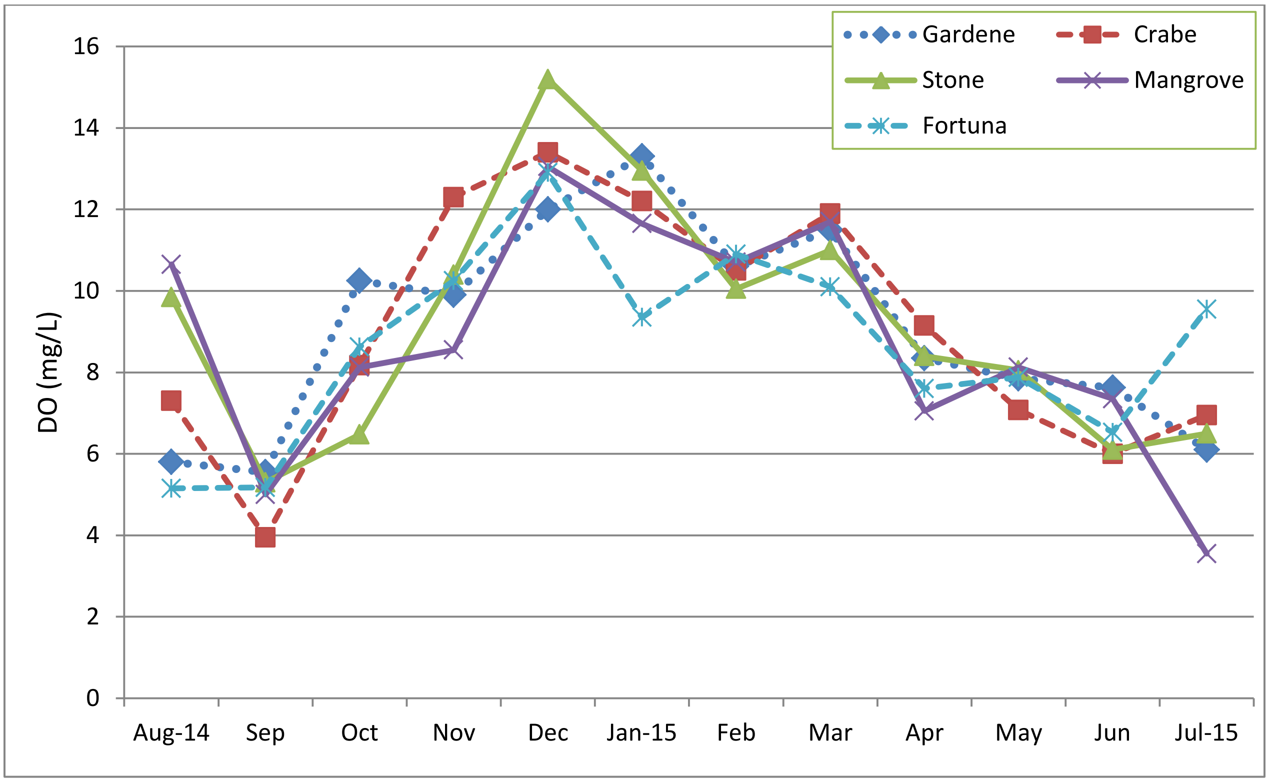

Figure 2.5 Dissolved oxygen levels for the South Pontchartrain Basin Public Oyster Seed Grounds since 2013 Assessment. Data presented are from discrete measurements on each reef.

Sedimentation/Subsidence

Sedimentation can affect oyster reefs negatively in several ways. Either through direct oyster mortality by burial or through reduced growth and reproduction. Covering of the reef material by silt can limit clean places for larval oyster attachment. During the 2015 assessment, divers noted on several reefs that much of the cultch had a thick covering of silt and still others had cultch that was completely buried. Oftentimes, sedimentation occurs during periods of high freshwater input. The majority of the input of freshwater to this portion of the Basin was from discharge through gaps in the Mississippi River levee south of Pointe a la Hache, and through fresh water diversion structures, as well as main-stem distributaries during high Mississippi River stages. During March 2015, the flow rate through Main Pass nearly tripled, while the flow rates through Bayou Lamoque and Mardi Gras Pass increased almost ten-fold (Figure 2.6). The flow rate through the Caernarvon Fresh Water Diversion also increased slightly during this same time period, but dropped dramatically the following month. Flow rates at Main Pass, Bayou Lamoque, and Mardi Gras Pass continued at an elevated rate through the remainder of the assessment period (Figure 2.7). In a healthy reef system, subsidence of the reefs is usually balanced by reef accretion or growth. However, if no appreciable shell is added over a period of time, the reefs, especially those in less than optimal environments, will subside to the point of shell burial. The lowering of the reef profile also subjects associated organisms to more frequent hypoxia events, as well as changing the local water flow and attributing to sedimentation processes.

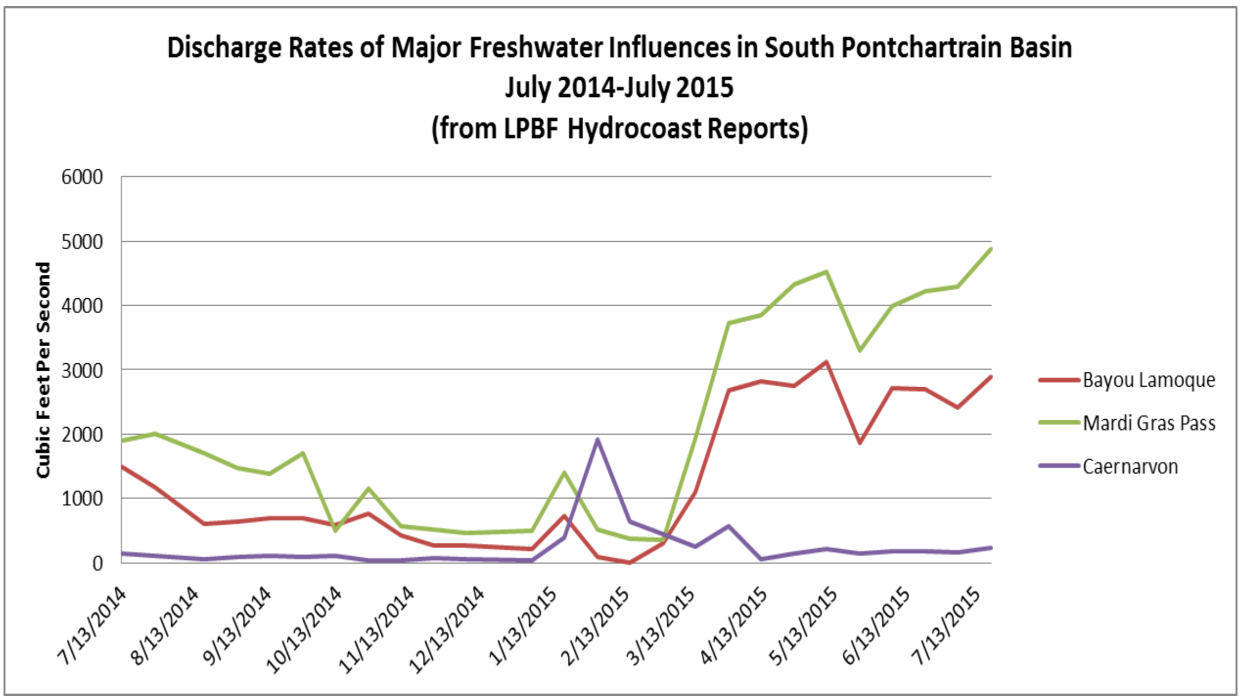

Figure 2.6. Discharge from Major Freshwater Influences in cubic feet / second for months of July 2014 through July 2015. Data are from discrete measurements taken by Lake Pontchartrain Basin Foundation for Hydrocoast Reports.

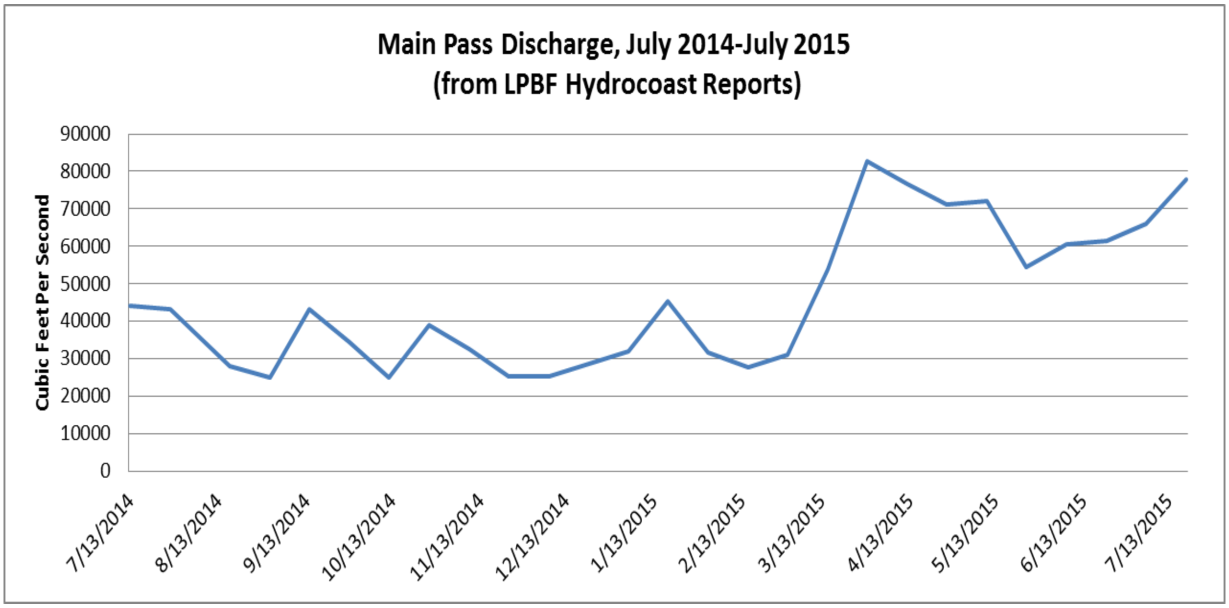

Figure 2.7. Discharge from Main Pass of the Mississippi River over time.. Data are from discrete measurements taken by Lake Pontchartrain Basin Foundation for Hydrocoast Reports.

Cultch Condition

Any successful spat set is dependent upon clean, stable cultch for larval attachment. The condition of the cultch and live oyster shell within the South Pontchartrain Basin currently appears to be poor. As noted above, many areas are either covered with a layer of silt or buried completely. On some reefs within the Basin, the cultch is nearly completely covered by fouling organisms such as hooked mussels (*Ischadium recurvum*), Spionid polychaete mud tubes, or ctenostomes and fairy lace bryozoans, all of which can pose hindrance to larval oyster settlement. In other areas, the addition of shell to a reef has become so infrequent that the cultch on hand is being transformed into small "hash" particles that provide minimal substrate for larval attachment.

<u>2014/2015 Oyster Season Summary</u>

The 2014/2015 oyster season on the South Pontchartrain Basin public oyster seed grounds opened on October 20, 2014 and closed on April 30, 2015. Lake Fortuna and Bay Long were opened as "sacking-only" areas, and there was a 50 sack per day limit levied across the entire Basin for the duration of the season. The Bay Gardene seed reservation, as well as the recent cultch plants at California Bay, Bay Crabe and Lake Fortuna remained closed to harvest throughout the 2014/2015 oyster season.

Harvest Monitoring Methods

Harvest totals for the 2014/2015 season were estimated by obtaining fisheries dependent data from the monitoring of users. "Boarding Surveys" were conducted weekly during the season. LDWF Biologists survey the entire area observing fishermen, recording locations, and making harvest estimates for each vessel for that day. This harvest estimate is projected over the amount of "fishable days" (winds less than 25 mph) for the week and a total harvest estimate of seed and market oysters for the week is made. Vessels collecting seed are often boarded to determine if excessive amounts of cultch (non-living reef material) are being removed from area reefs. Harvest data is also obtained via the trip ticket system in place for this fishery. This data is consolidated by geographic region and is considered preliminary until well after the season concludes, and provide a limited resolution.

Harvest Results and Discussion

Harvest totals for 2014/2015 were estimated at 8,207 sacks of market oysters and 14,500 barrels of seed oysters. When harvest estimates within stock-assessed areas are compared with the 2014 stock assessment, there was an estimated utilization of 7.3% of the sack resource and 49.2% of the seed resource. Harvest amounts as well as observed vessels were not constant over time. Sack harvest effort was primarily in the Lonesome Island Reef Complex, which accounted for 96.8% of the total estimated harvest of market oysters in the South Pontchartrain Basin. Lesser amounts of sack harvest were recorded at Bay Crabe, Lake Fortuna, and East Stone Island. Seed harvest during this assessment period occurred solely in the Lonesome Island Reef Complex, with the majority coming from the sites of 2007 and 2009 cultch plants. All observed seed harvest in this portion of the Basin took place during the first 2 weeks of the season. While obtaining fishery dependent data, LDWF biologists also collected random samples of loads from vessels harvesting seed oysters on the public grounds to check the percent of cultch (non-living reef material) being harvested. Samples were collected from five different vessels observed collecting seed oysters from during the 2014/2015 oyster season. As stated above, all bedding samples were collected from the Lonesome Island Reef Complex. These samples were measured to be 36.6%, 44.1%, 45.8%, 83.7%, and 94.4% non-living cultch material. This marks a continuation of excessive cultch removal from public reef systems by bedding vessels, on a percentage basis. Although total cultch removal during the 2014/2015 season was relatively low due to the low amount of overall harvest pressure, the loss of adequate cultch material continues to be a major concern for public seed grounds within the Pontchartrain Basin.

Barataria Basin (CSA3) – 2015 Oyster Stock Assessment

Introduction

Coastal Study Area (CSA) 3 consists of three public oyster areas distributed generally in a north-south direction within the Barataria Bay estuary: 1) Little Lake Public Oyster Seed Grounds (POSG), 2) Hackberry Bay Public Oyster Seed Reservation (POSR), and 3) Barataria Bay Public Oyster Seed Grounds (POSG). Hackberry Bay is the oldest of the three as it was designated by the Louisiana Legislature as a public oyster seed reservation in 1944. Barataria Bay was designated by the Louisiana Wildlife and Fisheries Commission (LWFC) as a public oyster seed ground in 2000, and Little Lake was designated by the LWFC in 2007. Historically, CSA 3 has monitored three sampling sites for annual oyster stock assessment, all in Hackberry Bay. Sampling has expanded in recent years, however, with the addition of the Barataria Bay POSG, and the addition of newly constructed oyster reefs in Hackberry Bay.

Hackberry Bay (Jefferson/Lafourche Parishes) is a 4,402 acre mesohaline embayment with a primarily soft silt and clay bottom, of which only 14.7 acres is naturally occurring reef material. The three historical sampling sites within Hackberry Bay are the upper, middle, and lower Hackberry sampling sites. The middle Hackberry site is the only site located over existing natural reef, while the upper and lower sites are over former cultch plants placed on top of historical reefs. The upper Hackberry sampling site was the result of a 1994 cultch plant using federal disaster funds from Hurricane Andrew in 1992. The upper site had also been the location of cultch plants in 1943 (140 acres), 1945 (70 acres), 1946 (92 acres) and 1981 (67 acres). The 1994 cultch site was comprised of six different sections of substrate including: crushed concrete, shucked shell, reef shell, clam shell, Kentucky limestone and Bahamian limestone totaling 145 acres. The lower Hackberry sampling site is on a reef that was part of a 450 acre 1973 cultch plant. Since very little natural reef exists in the Hackberry Bay POSR, production is highly dependent upon and reflective of when and where cultch plants are placed in the bay. It is unknown how much, if any, cultch material from the 1994 and earlier cultch plants remains exposed above the surface of the mud. Therefore, the acreage of these cultch plants is not factored into the annual oyster stock assessment.

Since 2004, five reef rehabilitation projects (cultch plants) have occurred in Hackberry Bay and one in Barataria Bay. In Hackberry Bay, two cultch plants were constructed in 2004 totaling 35 acres and one in 2008 totaling 50 acres. In 2004, a 40-acre cultch plant was constructed in the Barataria Bay Public Oyster Seed Ground.

In May 2012, utilizing early restoration funds following the BP oil spill, 26,086 cubic yards of limestone were placed on approximately 200 acres in the northwest portion of Hackberry Bay at a cost of $56.93 per cubic yard. Additionally, a 30-acre cultch plant was constructed in May 2014 in the northeastern portion of Hackberry Bay utilizing 3,572 cubic yards of limestone rock. These recent cultch plants have increased the estimated reef acreage on the Hackberry Bay POSR from 99.7 to 329.7 acres.

The Barataria Bay POSG was designated as a public oyster ground in response to possible changes in the salinity regime of the estuary stemming from the Davis Pond Freshwater Diversion project. Davis Pond is a large Mississippi River diversion project that aims to reintroduce freshwater and nutrients into the Barataria Bay estuary. As this new coastal restoration project was anticipated to reduce salinities in the estuary, LDWF felt that an additional public oyster seed ground farther down-estuary may be productive during years with high freshwater input. The only known existing reef in the Barataria Bay POSG is a 40-acre cultch plant constructed in 2004. The reef is comprised of 7,536 cubic yards of crushed concrete. The Barataria Bay cultch plant was constructed in May 2004 and is located in the northeast section of the Barataria Bay POSG. It is vulnerable to predators such as oyster drills and the protozoan parasite *Perkinsus marinus* - (Dermo) during periods of higher salinities. Consistent production is not expected until salinity regimes in the basin change due to natural forces or coastal restoration efforts.

On February 1, 2007 the Wildlife and Fisheries Commission created the Little Lake POSG. Previously, this area had been utilized as a temporary natural reef area, and was once covered with private oyster leases. These leases all fell within the Davis Pond freshwater diversion impact area and were either purchased or moved by the state and federal government prior to the opening of the Davis Pond diversion. The Davis Pond diversion has not been consistently utilized to its maximum capacity since it first opened in 2002, and environmental conditions during some years have allowed oysters to continue to exist in Little Lake. Therefore, the LWFC designated this area a public oyster ground so that oysters could be harvested and reefs could be actively managed by LDWF. The location of the Little Lake POSG makes it vulnerable to depressed salinities from rainfall, inflow from the Intracoastal Waterway, and discharge from the Davis Pond freshwater diversion. Reduced salinities from increased freshwater input can have a negative impact on oyster survival and availability. However, when higher salinities exist, the Little Lake POSG has provided the oyster industry with additional seed and sack oysters in the Barataria basin. Although very little information on reef acreage exists for Little Lake, LDWF hopes to better survey the area in the future.

Materials and Methods

Quantitative samples used in this assessment were collected by CSA 3 biologists on 6-8 July, 2015. Samples were obtained using a one square-meter (m^2) quadrat placed randomly on the bottom over reef at each sampling location. Using SCUBA, all live and dead oysters, as well as shell, in the upper portion (exposed) of the substrate were removed from the area within the quadrat. Live and dead oysters, fouling organisms, and oyster predators were identified and enumerated. All oysters were measured (mm) and placed into 5 millimeter work groups and further classified by size as spat (0-24mm), seed (25-74mm), and sack oyster (75mm and greater), then weighed in 10 gram increments. Seven stations were visited (Figure 3.1) with five replicate square meter samples taken at each location. The recent cultch plants in Hackberry Bay (2012 and 2014) were quantitatively sampled using replicate ¼ m^2 quadrats. Five random samples were collected on the 2012 cultch plant as well as on the 2014 cultch plant. The average of all replicates at each station was used, in combination with reef acreage, to estimate the current oyster availability for CSA 3.

The Little Lake POSG was not sampled due to lack of reef acreage information.

Results and Discussion

Seed and Sack Stock

Stock for the Hackberry Bay POSR, including the productive cultch plants, is estimated at 9,266.9 barrels (bbls) of seed size oysters and 8,396.59bbls of market size oysters for a total of 17,663.48bbls of overall stock. Seed were present at all stations, except for the 2004 Barataria Bay Cultch Plant, and Lower Hackberry Bay station. There was an overall -73.5% decrease in seed availability from 2014. Seed availability is down -14% below the past 10 year average (9,266.9 vs. 10,722), and -30% below the long term average from 1976-2014 (9,266.9 vs. 13,223.6). Sack oysters were present at all stations with the exception of the Lower Hackberry Bay cultch plant, the 2004 Hackberry Bay North cultch plant, and the Barataria Bay 2004 cultch plant. The 2004 Hackberry Bay South cultch plant had fewer sack oysters available compared to 2014 (0.4/m^2 vs. 1.2/m^2), along with Middle Hackberry Bay cultch plant (0.2/m^2 vs. 3.00/m^2). The 2008 Hackberry Bay cultch plant had the highest density at 7.8/m^2 (Figure 3.2). Including the Hackberry Bay 2012 and 2014 cultch plants, sack oyster stock was up +371% from 2014, +144% above the past 10 year average (8,396.59 vs 3,443.0), and +18% above the long term average of 7,095.7 (1976-2014) (Table 3.1, Figure 3.3). The combined stock of 17,663.5 barrels of seed and sack oysters showed an overall -52% decrease over 2014, however, a +25% above the 10 year average of 14,164.6, while also being -13% below the long term combined stock average (17,663.5 vs. 20,319.3). With an overall reduction in seed oyster stock at all stations, the combined stock increase over the 10 year average is attributable to an increase in sack oysters at the Hackberry Bay 2012 Cultch Plant and 2008 Hackberry Bay cultch plant. There were 4,384.1 barrels of sack oysters available at the 2008 Cultch Plant and 3,597.2 barrels available at the Hackberry Bay 2012 Cultch Plant.

The monthly average size of seed and sack oysters, from combined dredge and square meter samples, was 2.4 inches, ranging from 1.7 to 2.8 inches (Figure 3.4 and 3.5). The overall average size from July 2014 to July 2015 was 2.29 inches (Figure 3.5). No live seed or sack oysters were observed in the Barataria Bay (POSG) (Figure 3.1, Table 3.1). Market-size oyster availability has not been documented on the Barataria Bay (POSG) since it was created in 2004. The July 2015 average catch-per-unit-effort (CPUE) for both seed and sack oysters combined, as well as spat, seed, and sack oysters combined total, was lower than July 2014 and was also below the overall combined monthly average CPUE for dredge samples from August 2014 through June 2015 (Figure 3.6).

Spat Production

Unlike the total catch of 77 spat seen in 2014, there were only 20 total live spat collected in 2015. Spat abundance was well below the long term average since 1976 of 8.8 spat/square meter (2015 = 0.4 spat/square meter). The highest numbers were found at the 2008 Hackberry Bay Cultch Plant with 7 of the 20 total spat coming from that reef. No spat were collected on the Barataria Bay POSG in 2015. Since inception, the only stock assessment samples on the Barataria Bay POSG with a record of spat were in 2005 (8 spat per m^2), 2009 (53.5 spat per m^2), 2010 (5.2 spat per m^2), and 2013 (2.6 spat per m^2).

Fouling Organisms

The hooked mussel (*Ischadium recurvum*) is a reef-associated benthic bivalve species that competes with oysters for food and settlement surfaces. Hooked mussels were present at all sampling stations except in Barataria Bay POSG, Upper Hackberry Bay, and Lower Hackberry Bay stations. The highest density of 14 mussels/m^2 was observed at the Hackberry Bay 2008 Cultch Plant station (Table 3.2). The average number of hooked mussels observed in the Hackberry Bay POSR was 2.9/m^2, reduced from last year's average of 28.5/m^2. The Middle Hackberry Bay site accounted for most of the overall decrease with only 3 mussels per square meter in 2015 versus the 102 mussels per square meter in 2014. Monthly average salinities in Hackberry Bay were below the long term average (LTA) since February 2015 prior to square meter sampling (Figure 3.7). The average salinity for Hackberry Bay POSR in June 2015 was 3.4ppt, still well below the long term average salinity for June of 11.4ppt.

Mortality

Recent spat mortality at each station on the Hackberry Bay POSR ranged from 0 to 50% with an overall average of 23.1%, elevated from the 10.5% overall average in 2014. Recent seed oyster mortality at each station ranged from 0 to 14.8% averaging 7.8%. Recent sack oyster mortality at each station ranged from 0 to 50% and a combined overall spat, seed, and sack mortality of 12.7% (Table 3.2, Figure 3.8). Only three recently dead spat-sized oysters were observed on the Barataria Bay POSG.

Additional sources of oyster mortality data available since the 2014 oyster stock assessment are the monthly dredge samples. Dredge samples revealed an overall combined spat, seed, and sack average monthly mortality of 2.8% between July 2014 and June 2015 (Figure 3.8). This was lower than the 4.6% overall monthly mortality observed during the same time period prior to the 2014 stock assessment sampling. Although the average monthly mortality for the past twelve months appears low, elevated mortalities in June and July 2015 were documented.

Oyster Predators

The southern oyster drill (*Stramonita haemastoma)* is a predatory marine snail that feeds on oysters and other sessile organisms using a radula (a small tooth-like rasping organ) to bore a hole through the shell. During sampling for the 2015 stock assessment only one oyster drill was sampled from the Barataria Bay POSG. Since 2009 only 21 oyster drills have been sampled during dredge and square meter sampling and most of those have come from the Barataria Bay POSG. Mortalities of oyster drills have been reported from Mississippi Sound when salinities fell below 8-10 parts per thousand (ppt), therefore, the absence of oyster drills from almost all 2015 samples is most likely due to the low overall average salinities throughout the basin beginning in February of 2015 (Figure 3.9).

Tropical and Climatic Events

The United States Army Corps of Engineers (USACE) Tarbert gauge recorded Mississippi River discharge from January 2014 through June 2015 as below the long term average (1961-2014) of 594,000 cubic feet per second (cfs), and reaching a peak discharge for 2015 at 935,000 cfs in April. Discharge levels remained above the average in June at 803,194 cfs prior to our sampling effort in July 2015 (Figure 3.9).

The United States Geologic Survey (USGS) constant data recorder, located near the Davis Pond diversion structure, recorded a monthly average discharge below the long term monthly average of 1,831cfs until December 2014, where it rose to over 1,776 cfs and continued to rise for the next four months. This coincided with the rise in discharge of the Mississippi River and reached a monthly average discharge of 4,036 cfs on the Davis Pond gauge in March. Between March 15th, 2015 and March 25th 2015 the Davis Pond diversion was operated at over 8,000 cfs with a maximum of 10,200 cfs on March 17th. Subsequently the discharge was reduced to a monthly average of 999 cfs in April 2015. Average monthly discharge rates were below the long term average discharge (2003 to 2014) for each month between July 2014 and June 2015, except for March 2015 (Figure 3.10).

Hackberry Bay POSR salinities from January 2014 to June 2015 averaged 9.9 parts per thousand (ppt) with a range of 3.4 to 18.2ppt (Figures 3.7, 3.9, & 3.10). The average salinity for June 2015 was 3.4 ppt which remained well below the 1996 to 2014 June long term monthly average of 11.4 ppt. Monthly average salinities for Hackberry Bay POSR have been below the long term monthly average since January 2015. Utilizing the Habitat Suitability Index (HSI) model from oystersentinel.org, the average salinity values listed above, along with a potential 100% bottom covered with suitable cultch, yielded only an HSI value of 0.00 or “Unsuitable” oyster habitat for Hackberry Bay POSR 2015. This is degraded from the HSI value of 0.41 from 2014. Elevated Mississippi River discharge, combined with increased discharge from the Davis Pond structure, and above average rainfall over the previous four months, had reduced salinity in Hackberry to below the long term monthly average. These unsuitable oyster habitat conditions over such an extended period of time have likely negatively impacted the oyster population within the Hackberry Bay POSR leading to the decrease in seed oyster availability seen during the 2015 Stock Assessment sampling.

Salinities in the Barataria Bay POSG from January 2014 to June 2015 averaged 16.7 ppt with a range of 8.3 to 23.2 ppt (Figure 3.9 and 3.10). Utilizing the Habitat Suitability Index (HSI) model from oystersentinel.org, the average salinity values listed above, along with a potential 100% bottom covered with suitable cultch, yielded an HSI value of 0.67 or “Fair Habitat”for the

Barataria Bay POSG. Therefore, it would be expected that some level of oyster resource would be available on the Barataria Bay POSG. We sampled 3 recently dead spat from one quadrat on the Barataria Bay POSG, which extrapolated into 90,125 recently dead spat over the 40 acre reef. It is possible that with a suitable HSI value a spat set occurred this spring on the Barataria Bay POSG, however, one southern oyster drill was also sampled, which extrapolated to 32,375 over the 40 acre reef and likely the source of mortality for those spat oysters.

Salinities in the Little Lake POSG from January 2014 to June 2015 averaged 4.8 ppt with a range of 0.75 to 11.7 ppt (Figure 3.9 and 3.10). Utilizing the Habitat Suitability Index (HSI) model from oystersentinel.org, the average salinity values listed above, along with a potential 100% bottom covered with suitable cultch, yielded an HSI value of 0.00 or "Unsuitable Habitat"for the Little Lake POSG. This HSI value likely explains the high mortalities and low catch effort seen for the replicate dredge samples conducted in Little Lake POSG during July 2015.

No tropical systems have affected the study area since Hurricane Isaac in 2012.

Non-Climatic Events

Areas around Bay Jimmy, Grand Terre and the mouth of the Mississippi river which were previously closed to oyster harvest, due to impacts from the BP MC252 oil spill, were reopened on June 9th, 2015 and are no longer closed to oyster harvest.

<u>2014/2015 Oyster Season Summary</u>

The Little Lake POSG and Barataria Bay POSG opened from September 3rd through October 12th 2014 for seed oyster harvest only, then remained open from October 12th through April 30th, 2015 for seed and market sized oyster harvest with a 50 sack limit per vessel per day for market sized oysters only. The Hackberry Bay POSR remained closed to public seed/sack harvest for 2014/2015 season due to low numbers of seed oysters present during the 2014 Oyster Stock Assessment. Total harvest from public grounds in CSA 3 during the 2014/2015 season was estimated at 850.2 bbls of seed and sack oysters within Little Lake POSG, coming from 17 vessels boarded. Based on the Sustainable Oyster Shellstock (SOS) model it would be expected to see an increase in available stock by the model for the 2014-2015 harvest season due to the Hackberry Bay (POSR) being closed to oyster harvest.

The removal of reef material from public reefs during seed-oyster harvest has long been a concern to LDWF biologists as the practice threatens the long-term sustainability of the oyster resource on the public grounds. To assess the amount of reef material being removed, LDWF biologists collected three random one-cubic foot samples from each harvest vessel, when available. In each sample, any material having live seed or sack oysters was separated from material without live oysters. Large clusters were culled. The percentage of cultch removed was calculated by dividing the weight of the material without seed or sack oysters by the total weight of the material contained in the cubic foot container. Data from the three samples were averaged to obtain a percent cultch estimate for each vessel. Only one vessel was sampled during the harvest season and the overall average of cultch removed by that vessel from the Little Lake POSG was 33% of the vessel's load.

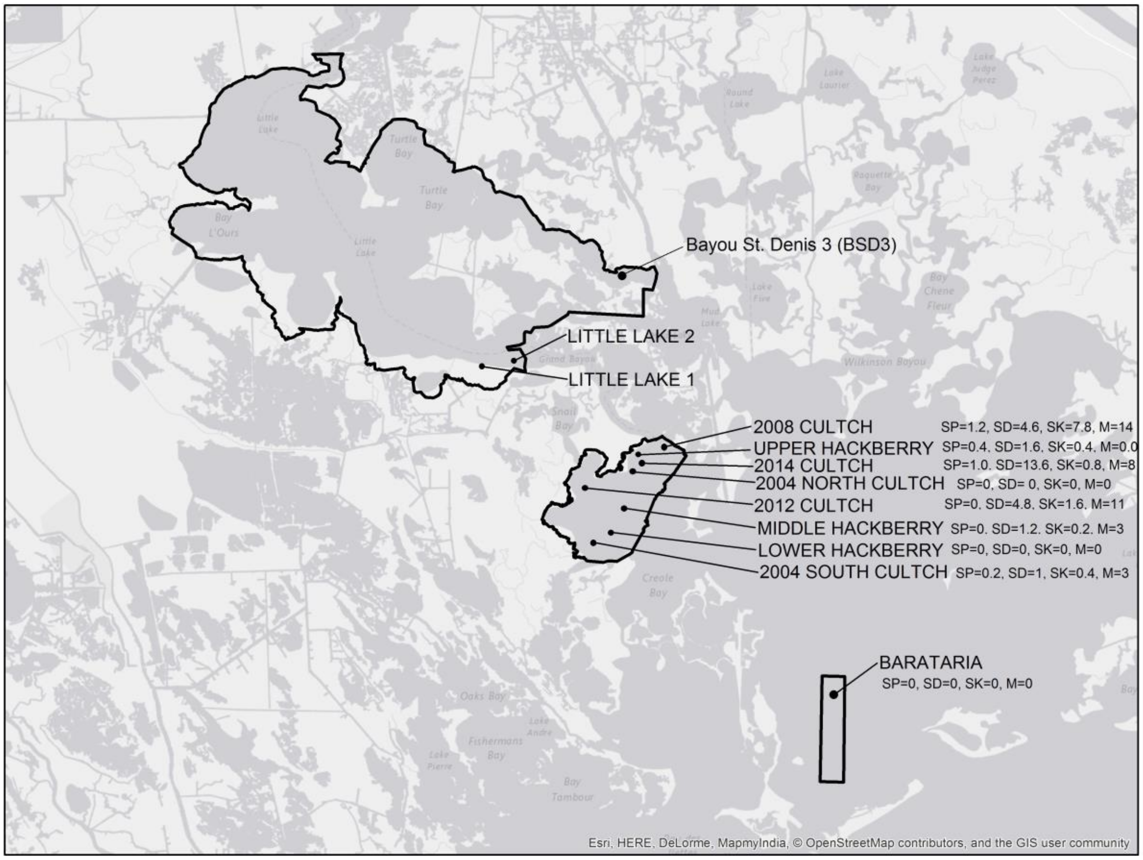

Figure 3.1 Map showing 2015 Hackberry Bay POSR and Barataria Bay POSG sample results as an average per square meter (SP=Spat, SD=Seed, SK=Sack, and M=Mussels

Table 3.1 2015 square meter results for the Barataria Basin (CSA 3).

Station	No.	Approx Reef Acres	Average Live Seed Oysters / M2	Average Live Sack Oysters / M2	Barrels of Seed Available	Barrels of Sack Available	Oyster Spat/M2
Hackberry Bay 2004 North Cultch Plant	6	10	1.2	0.00	67.4	0.0	1.0
Hackberry Bay 2004 South Cultch Plant	7	25	1.00	0.4	140.5	112.4	0.2
Hackberry Bay 2008 Cultch Plant	9	50	4.60	7.80	1,292.8	4,384.1	1.4
Hackberry Bay 2012 Cultch Plant	10	200	4.80	1.6	5,395.8	3,597.2	0.0
Hackberry Bay 2014 Cultch Plant	11	30	13.6	0.8	2,293.2	269.8	1.0
Lower Hackberry Bay	1	4.9	0.0	0.00	0.0	0.0	0.0
Middle Hackberry Bay	2	4.9	1.2	0.2	33.0	11.0	0.0
Upper Hackberry Bay	3	4.9	1.6	0.4	44.1	22.0	0.4
Barataria Bay 2004 Cultch Plant	8	40	0.0	0.0	0.0	0.0	0.0
Little Lake		Unknown	Unknown	Unknown	Unknown	Unknown	
Totals		369.7			9,266.9	8,396.6	4.0

	2014	2015	% Change
Seed	34,924.0	9,266.9	-73.5%
Sack	1,782.7	8,396.6	371.0%
Total	36,706.6	17,663.5	-51.9%

Table 3.2 2015 square meter predator/mortality results for the Barataria Basin (CSA 3).

Station	Station No.	Hooked Mussels/m^2	Oyster Drills Present	Spat Percent Mortality	Seed Percent Mortality	Sack Percent Mortality	Seed & Sack Percent Mortality	All Size Percent Mortality
Hackberry Bay 2004 North Cultch Plant	6	1	0	0.0%	0.0%	0.0%	0.0%	0.0%
Hackberry Bay 2004 South Cultch Plant	7	3	0	0.0%	0.0%	33.3%	12.5%	11.1%
Hackberry Bay 2008 Cultch Plant	9	14	0	12.5%	14.8%	11.4%	12.7%	12.7%
Hackberry Bay 2012 Cultch Plant	10	11	0	0.0%	14.3%	50.0%	27.3%	27.3%
Hackberry Bay 2014 Cultch Plant	11	8	0	0.0%	5.6%	0.0%	16.7%	4.2%
Lower Hackberry Bay	1	0	0	0.00%	0.0%	0.0%	0.0%	0.0%
Middle Hackberry Bay	2	3	0	0.0%	0.0%	0.0%	0.0%	0.0%
Upper Hackberry Bay	3	0	0	50.0%	0.0%	0.0%	0.0%	14.3%
Barataria Bay 2004 Cultch Plant	8	0	1	100.00%	0	0	N/A	N/A
Little Lake		N/A						

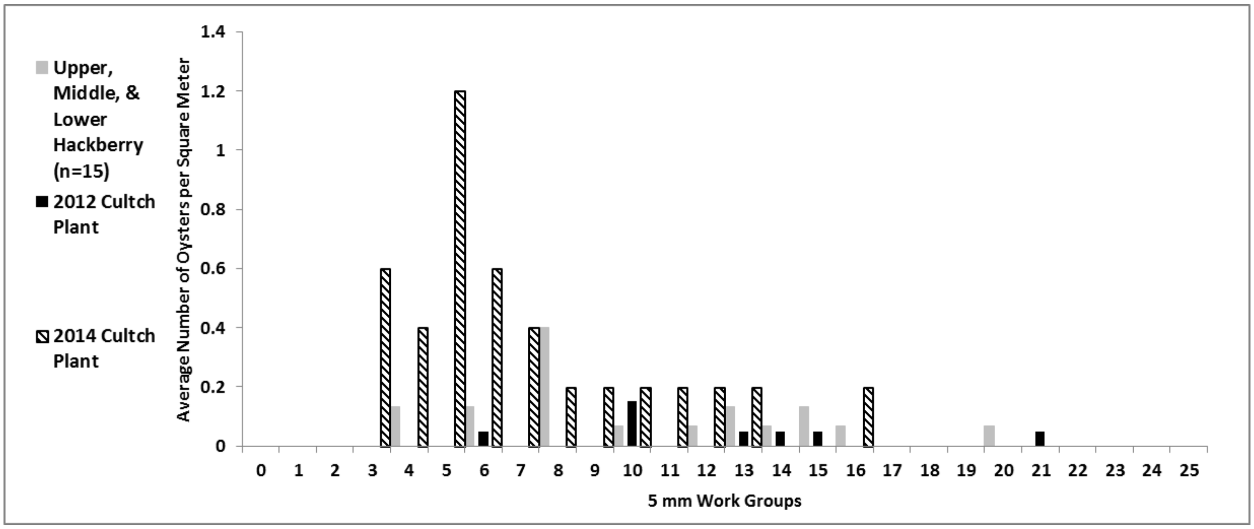

Figure 3.2 Oyster size distribution by 5 mm work groups in historic square meter samples compared to those collected from the 2012 Hackberry Bay Cultch Plant and 2014 Hackberry Bay Cultch Plant in 2015, illustrating that the majority of the seed oyster availability is from the 2014 Cultch Plant.

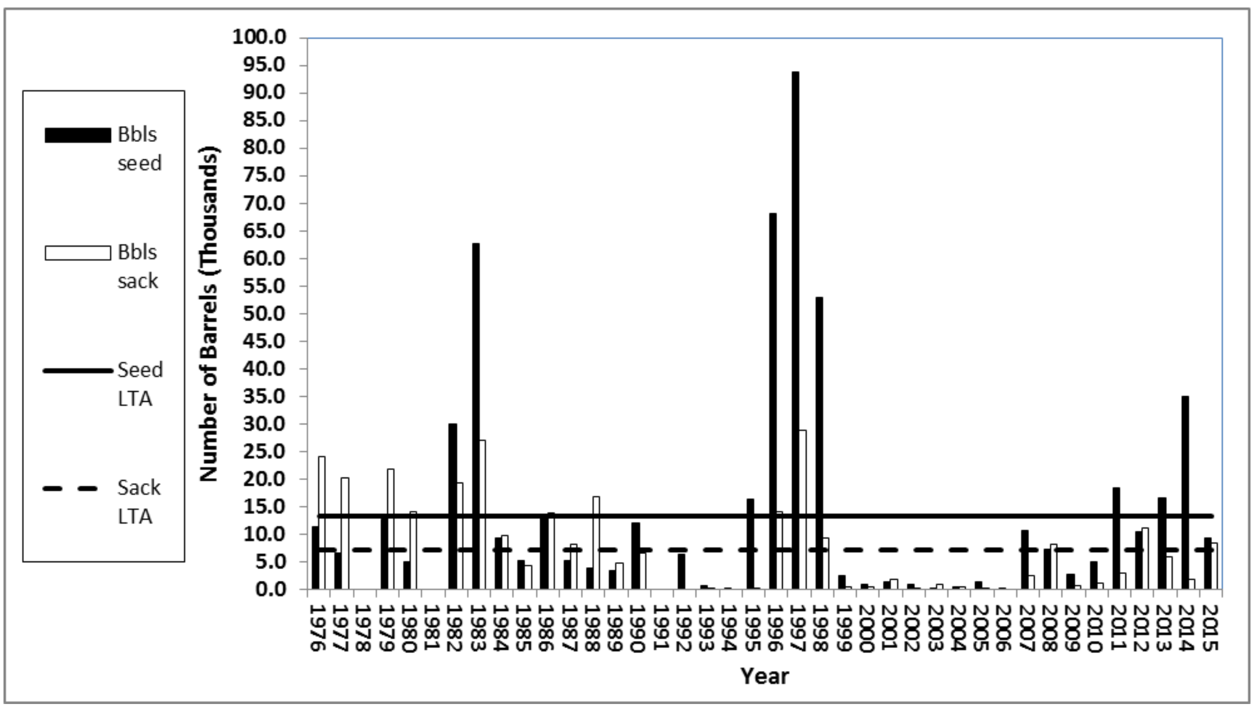

Figure 3.3 Estimated seed and sack oyster availability in the Hackberry Bay POSR from 1976 to 2015 compared to long term average seed and sack abundance.

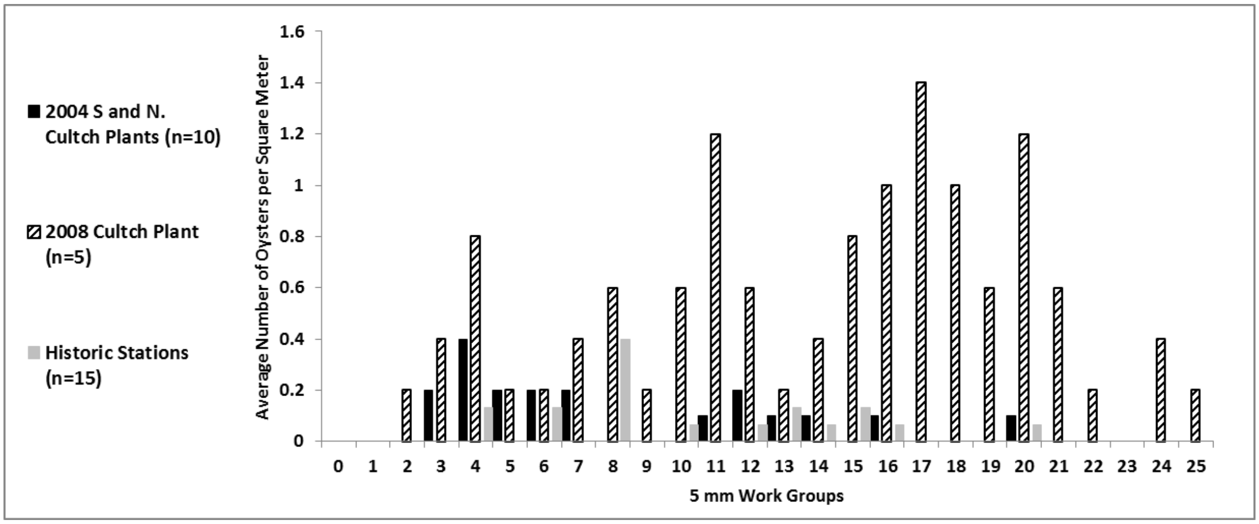

Figure 3.4 Oyster size distribution by 5 mm work groups in square meter samples collected from the Hackberry Bay POSR during 2015, illustrating that the majority of seed and sack oysters coming from the 2008 Cultch Plant.

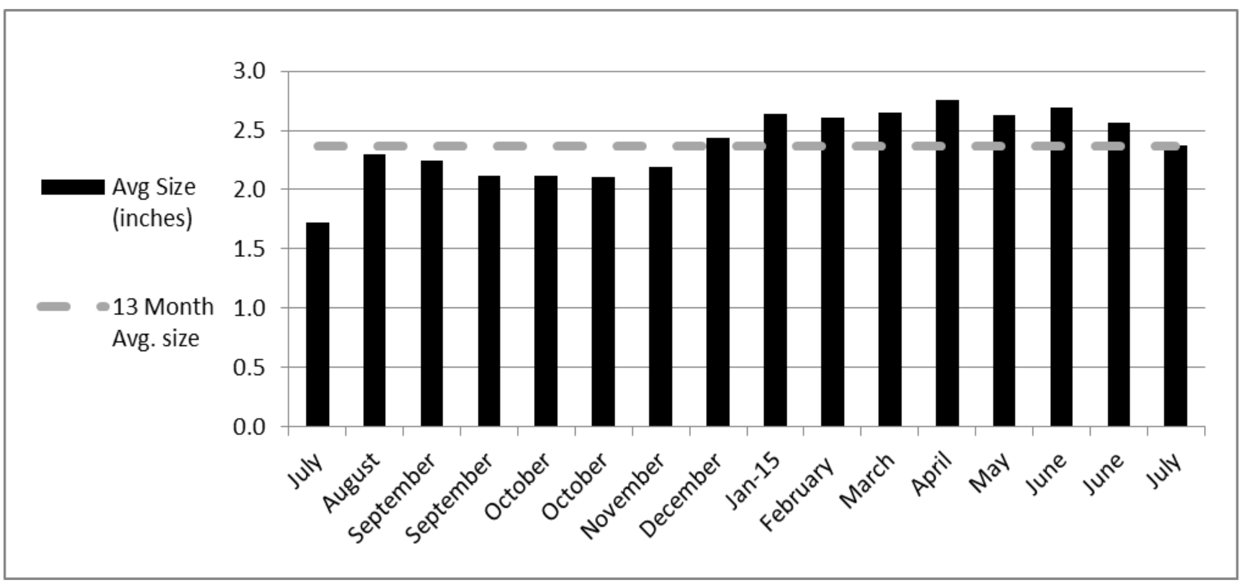

Figure 3.5 Monthly average oyster size for dredge samples and square meter (July 2014/2015) samples.

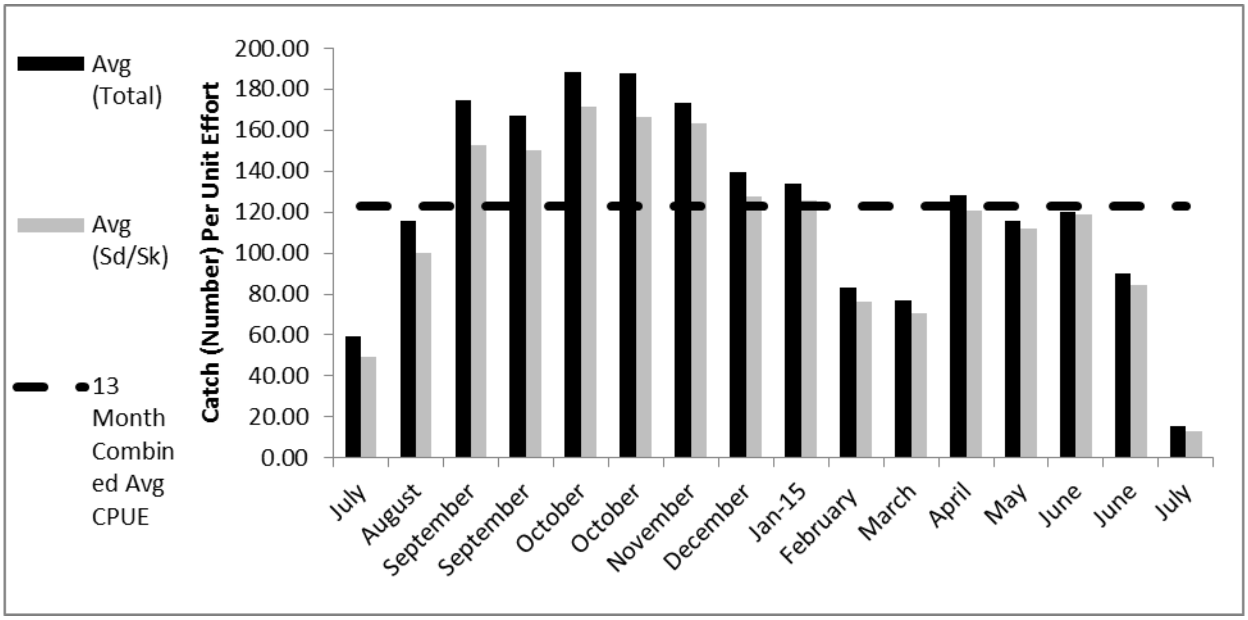

Figure 3.6 Monthly Catch Effort for 2 replicate dredge samples taken at 6 Hackberry stations combined per month. July Catch Effort based on square meter samples.

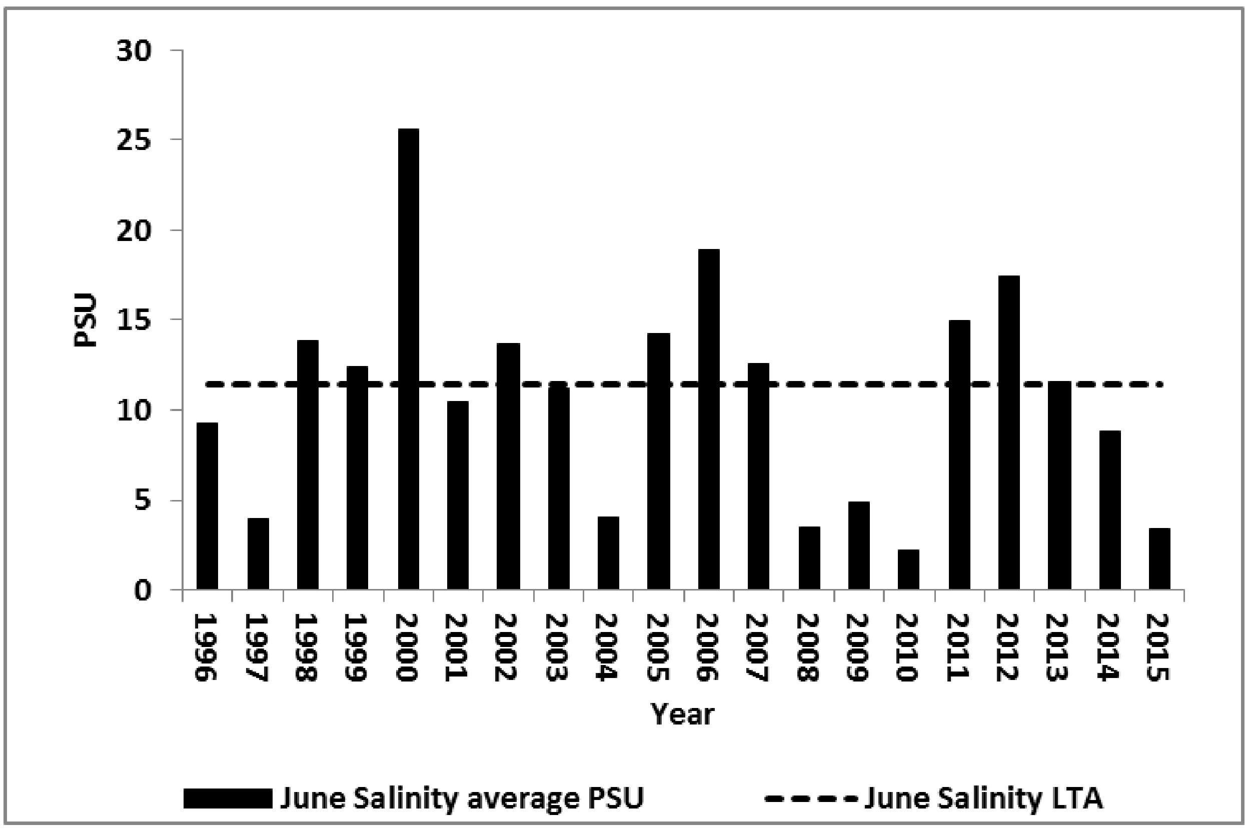

Figure 3.7 Historical annual and long-term average monthly salinity for the month of June in Hackberry Bay from 1996-2015. Data supplied by the United States Geological Survey (USGS) constant data recorder located in Hackberry Bay.

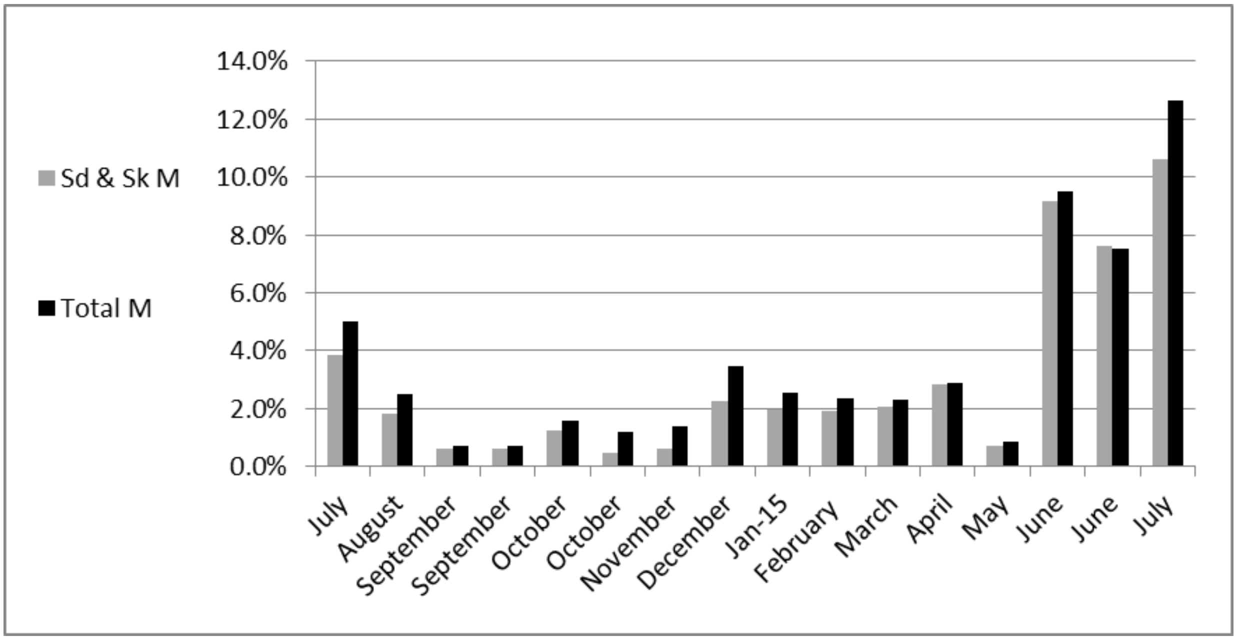

Figure 3.8 Overall oyster percent mortality and seed/sack mortality combined.

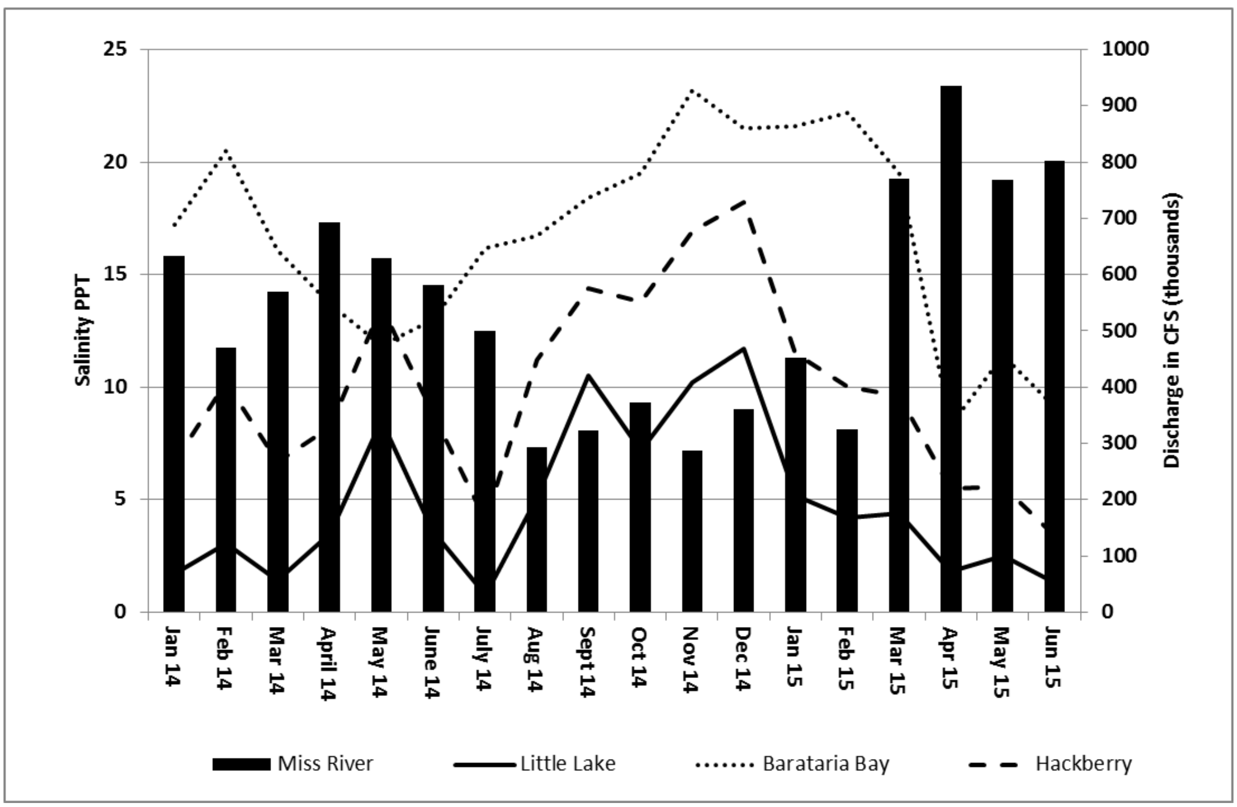

Figure 3.9 Mississippi River discharge vs. average monthly salinities in the Barataria Bay POSG, Little Lake POSG and Hackberry Bay POSR. Mississippi River discharge data supplied by the United States Army Corps of Engineers (USACE).

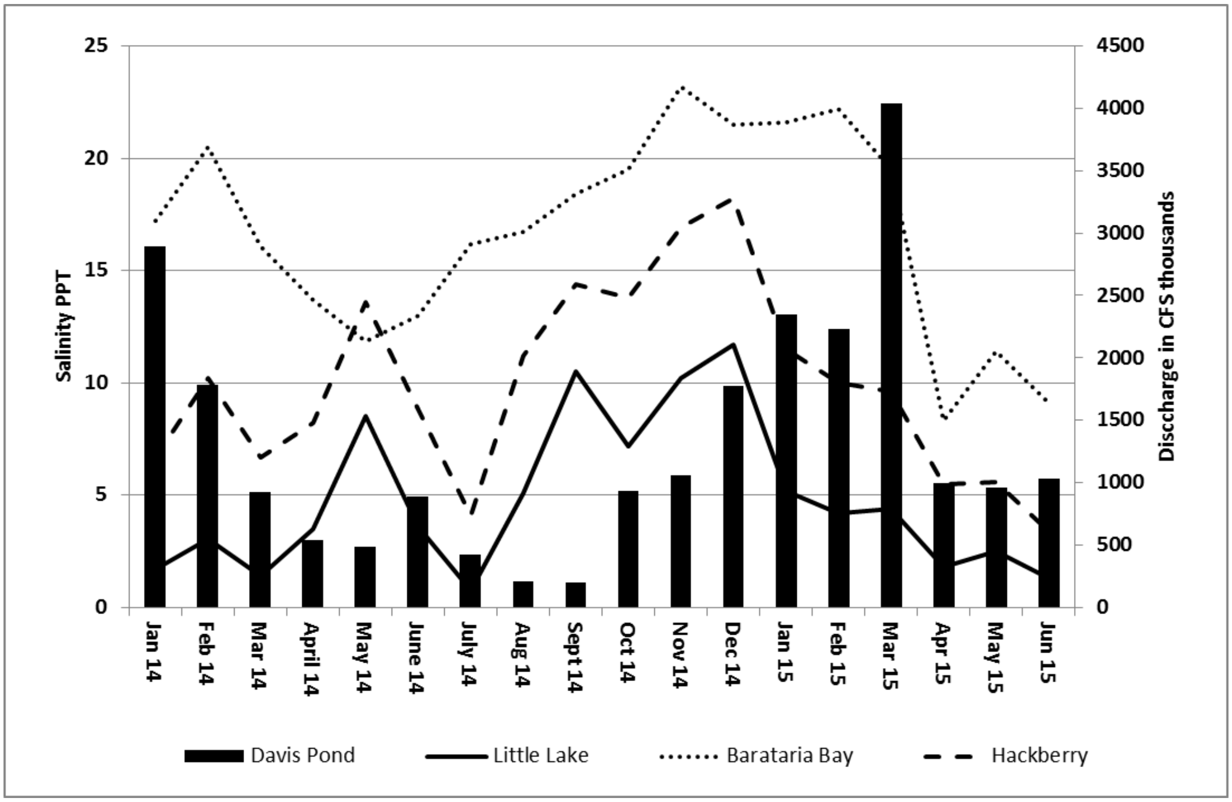

Figure 3.10 Davis Pond discharge vs. average monthly salinities in the Barataria Bay POSG, Little Lake POSG and Hackberry Bay POSR. Davis Pond discharge data supplied by the United States Geological Survey (USGS) constant data recorder located near the Davis Pond structure.

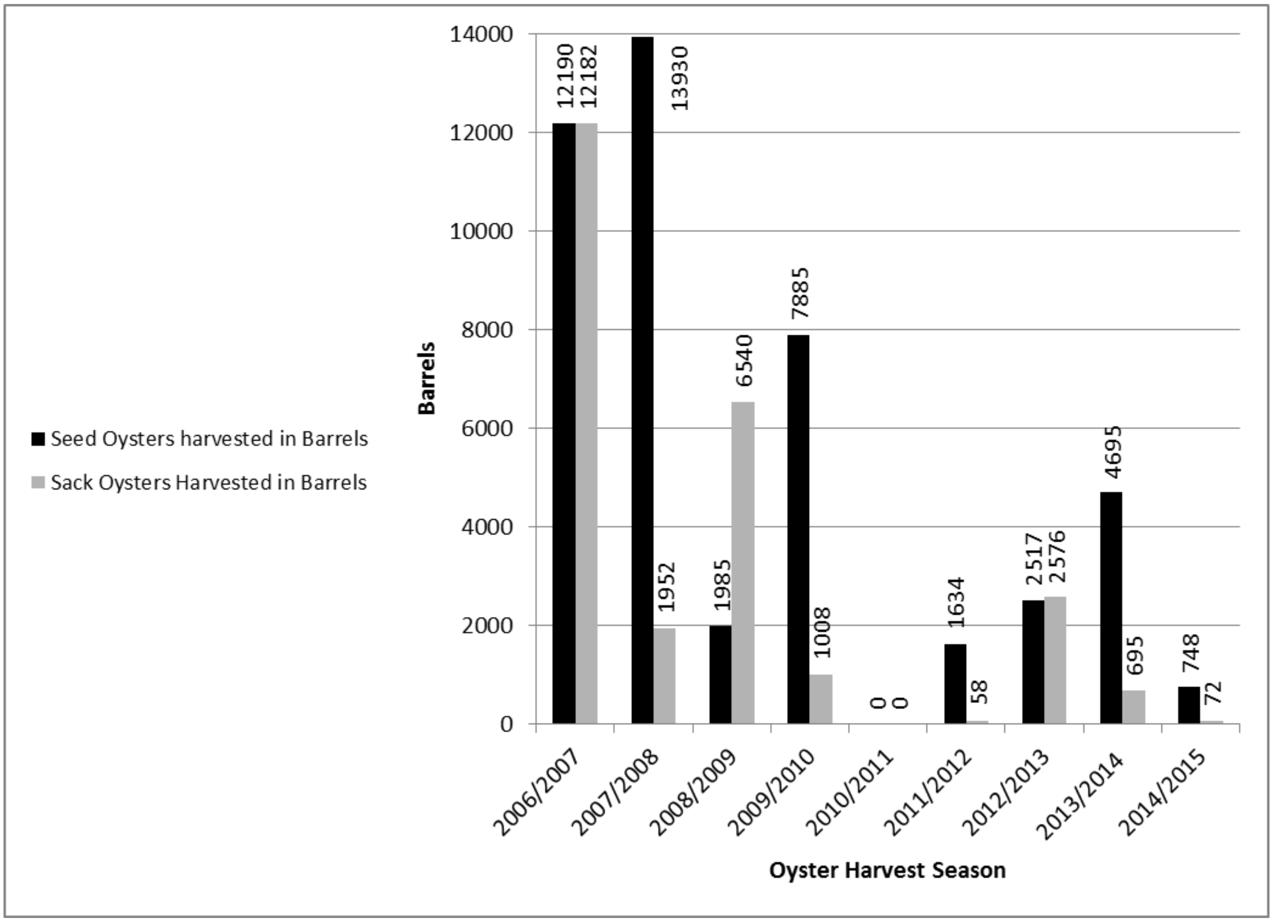

Figure 3.11 Estimates of oyster harvest from the public oyster areas in Coastal Study Area 3 for the past nine harvest seasons based on boarding report surveys (on-water interviews of harvesters). 2014/2015 estimates are for Little Lake POSG only.

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Terrebonne Basin (CSA5) – 2015 Oyster Stock Assessment

Introduction

The Terrebonne Basin (TB) includes that area from Bayou Lafourche west to the Atchafalaya River, and includes Terrebonne Bay and Timbalier Bays, Sister Lake, Lake Mechant, and Caillou Bay. Assessments are grouped into the eastern and western portions of the TB for presentation purposes.

There are currently eight different Public Oyster Seed Reservations (POSR) or Public Oyster Seed Grounds (POSG) within the Terrebonne Basin; these include Sister Lake (Caillou Lake) POSR, Bay Junop POSR, Lake Mechant POSG, Deep Lake POSG, Lake Felicity POSG, Lake Chien POSG, and Lake Tambour POSG. Sister Lake, Bay Junop, and Lake Mechant are located in the western TB while Deep Lake, Lake Felicity, Lake Chien, and Lake Tambour are found in the eastern TB (Figures 5.1 and 5.2).

Sister Lake (Caillou Lake) (Figure 5.1) was designated as a POSR in 1940 and includes 9,150.5 acres of water bottoms. The first known cultch deposition projects were established here between 1906 and 1909 by the U.S. Bureau of Fisheries. Subsequent plantings by the State of Louisiana began in Sister Lake in 1917; since then 21 cultch plants totaling 4,862.5 acres have been constructed, with some cultch plants being located on top of older ones or on top of existing reef habitat. Recent Sister Lake cultch deposition projects included a 67-acre site in 2004, a 156- acre site in 2009, and a 358- acre site in 2012. The 2012 early restoration cultch plant was originally designed to encompass 167 acres, but was increased to 300 acres during later planning; however some additional material was placed on the southern end of the plant during construction, increasing the final acreage to 358. The majority of the 2012 cultch plant was placed atop existing reef and made a minimal addition, less than 100 acres, to the total available reef acres in Sister Lake. For stock assessment purposes, the cultch plant was combined with a small amount of adjacent reef acreage and, thus, sampling on this cultch plant will represent oyster conditions on 364.8 acres of reef. The current total reef acreage for Sister Lake is estimated to be 2,375.36 acres.

The Bay Junop POSR (Figure 5.1) was established in 1948 and consists of approximately 2,646.5 acres of water bottoms. Due to the shallow water depth of the bay and inability of barges and tugs to enter for cultch deposition, no reef-building projects have been implemented in this area to augment natural oyster reef production. Available public reef acreage in this bay is estimated at approximately 252 acres.

The Lake Mechant POSG (Figure 5.1) was designated in 2001 with approximately 2,100 acres of water bottoms. In 2004, a 30-acre cultch plant was established. In 2007, un-leased water bottoms between the POSG and private oyster leases were added, increasing water bottom acreage within the public oyster seed ground to 2,583 acres. The total reef acreage outside of the 2004 cultch plant remains unknown.

The Lake Tambour, Lake Chien, Lake Felicity, and Deep Lake POSGs (Figure 5.2) were established in 2001. The upper portion of Lake Felicity was used as a public seed reservation during the 1940s and early 1950s, but was discontinued because salinities were usually too high for oyster production. However, future planned coastal freshwater diversion projects may return the area to a more favorable salinity regime for oyster production.

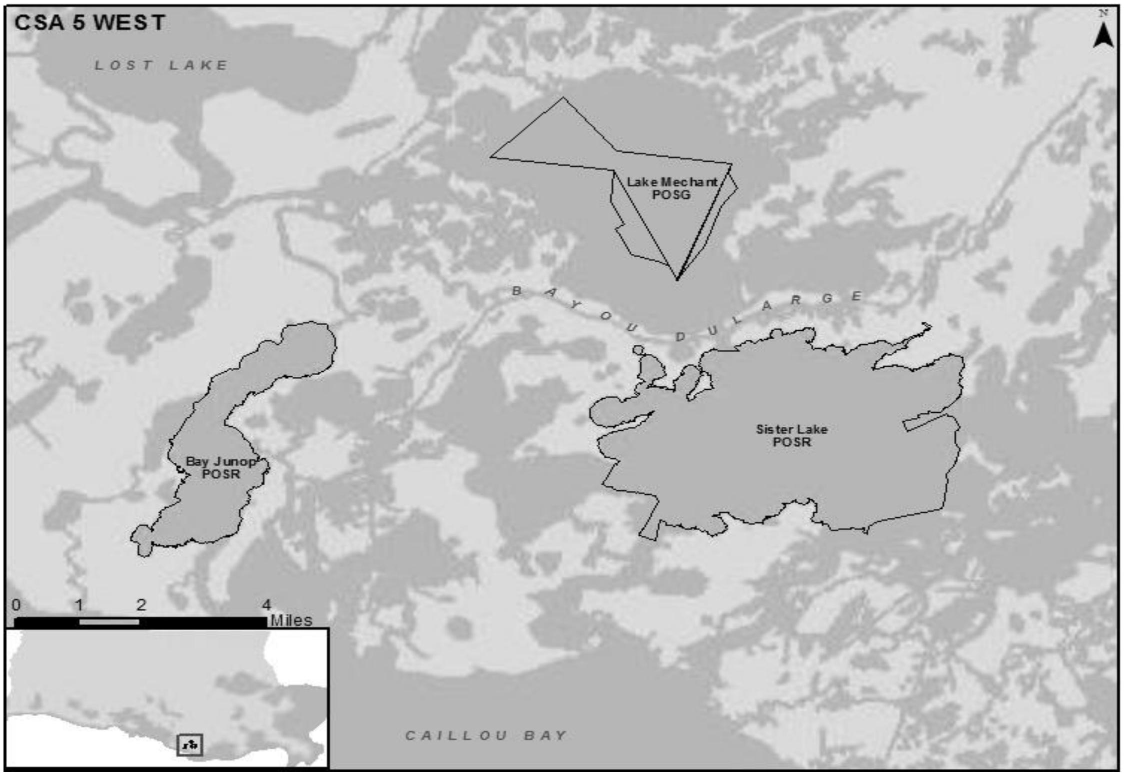

Figure 5.1 Public oyster areas within the western portion of Coastal Study Area (CSA) 5.

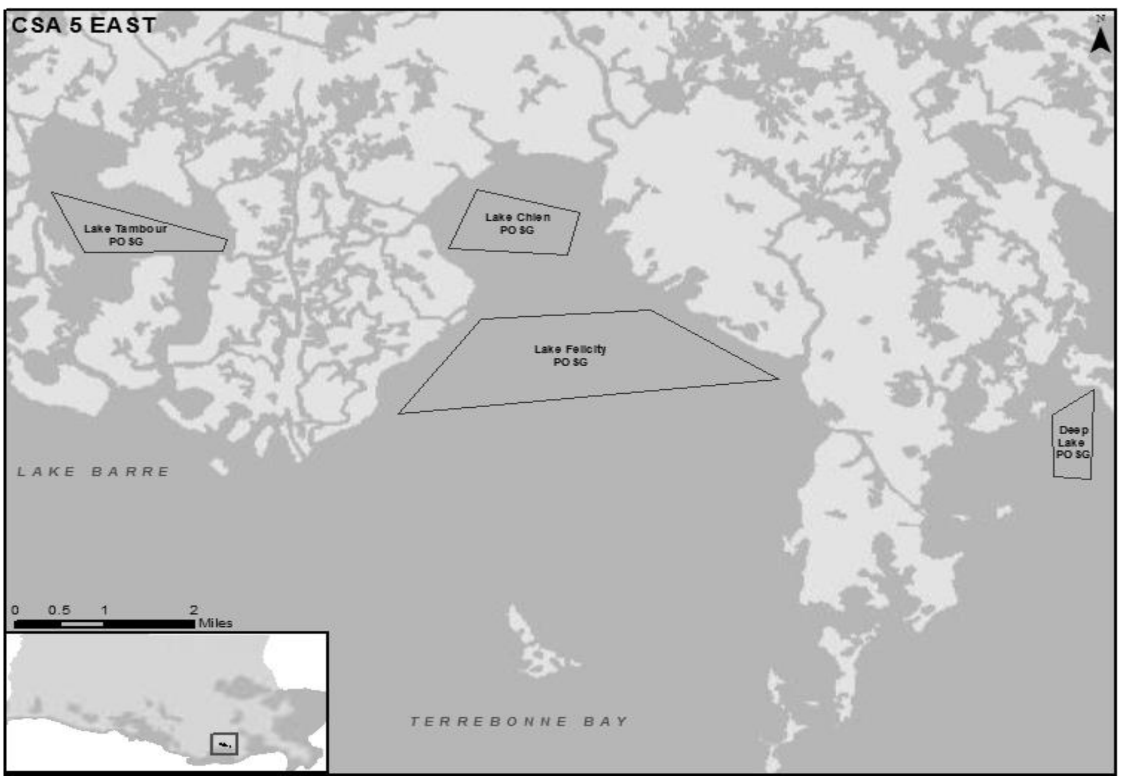

Figure 5.2 Public oyster areas within the eastern portion of Coastal Study Area (CSA) 5.

Lake Chien and Lake Felicity POSGs together have three cultch plants. Cultch deposition projects in Lake Chien (16 acres) and Lake Felicity (40 acres) were completed in the summer of 2004. Another 22-acre cultch plant was created in Lake Chien in May 2009 due east of the initial Lake Chien cultch plant. Outside of these cultch plants, there is no known reef in these areas and no reef development projects have been implemented in Lake Tambour or Deep Lake.

Materials and Methods

Square-meter field samples were collected on July 1, 2015 on existing oyster reefs in Lake Felicity and Lake Chien. Sampling was conducted at Sister Lake, Bay Junop, and Lake Mechant on July 7 – 8, 2015.

SCUBA divers collected five replicate samples at each station using an aluminum square meter quadrat that was tossed randomly over the reef. At the 2012 cultch plant location, a ¼ square-meter quadrat was utilized in lieu of a square-meter quadrat and five replicates were taken at randomly-chosen locations on the cultch plant. All oysters, loose shell and other organisms were removed from the upper portion of the substrate within the quadrat. Live and dead oysters, oyster predators, and hooked mussels (*Ischadium recurvum*) were separated and counted. Oysters were measured in 5 millimeter (mm) size groups and subsequently divided into three categories: spat (<25 mm), seed (25-74 mm), and sack (75 mm and larger) oysters. In conjunction with square meter oyster samples, water temperature and salinity data were also collected.

The average number of seed and sack oysters per square meter sample at each station was used to estimate oyster stock availability by extrapolation using historical known reef acreage. The footprint of the 2012 cultch plant, along with the combining of stations on overlapping reefs, resulted in a small adjustment of acreage in Sister Lake for the 2013 assessment. This adjustment in acreage was maintained for the 2015 assessment, details on stations and reef complexes affected can be found in the 2013 Oyster Stock Assessment Report (LDWF, 2013).

Results and Discussion

Resource Availability

The overall 2015 estimated resource availabilities in the Terrebonne Basin POSGs and POSRs are 141,923 barrels of seed oysters and 58,615 barrels of sack oysters in the western basin (Sister Lake, Bay Junop, and Lake Mechant), and 1,363 barrels of seed oysters and 710 barrels of sack oysters in the eastern basin (Lake Felicity and Lake Chien) (Tables 5.1 – 5.3).

Average number of oysters per square meter sample station ranged from 0 to 60.8 for seed sized, and 0 to 12.0 for sack sized oysters (Figures 5.3 - 5.5). All estimates of seed and sack oyster resource availability in 2015 were below long-term historic means (Figures 5.6 - 5.10).

In Sister Lake, the most productive oyster area in the Terrebonne Basin, estimated 2015 seed oyster availability was 6% below and sack oyster availability 50% below long-term means. However, 88% of the available seed resource and 85% of market sized oysters are located on the 2012 Cultch Plant, which has yet to be opened for legal harvest. Although Sister Lake has not been opened for legal harvest since 2013, illegal harvest from the POSR has become a real problem. Multiple cases are made by LDWF Enforcement on a near monthly basis, and are undoubtedly a fraction of the illegal harvesting activity taking place. This undocumented harvest is a likely contributor to the decline in available resource.

During this year's assessment, up to 6" of overburden was recorded at 10 of 11 sample sites in Sister Lake. The historically productive Grand Pass reef complex had overburden present at 9 of 15 replicate samples, and all nine were devoid of oysters.

Lake Mechant and the northern portion of Bay Junop, near Buckskin Bayou (station 3038), receive input from the Atchafalaya River via Blue Hammock Bayou. With the persistent high river stage this year, salinities have remained suppressed and sedimentation has increased; and is a likely cause for continued low resource availability.

In the eastern basin, Lakes Chien and Felicity's oyster resource availability was 82% below long-term means for seed and 60% below long-term means for market oysters. Estimated market sized oyster availability in Lake Chien is higher than 2014 estimates, and just below the long term mean (Table 5.4). The Lake Chien 2009 Cultch Plant contains 85% of this estimated market sized resource.

Continued marsh degradation in the eastern Terrebonne basin allows salinities to fluctuate widely based on prevailing wind direction, and the constant erosion adds sediment to the system which can increase reef burial. The majority of the Lake Felicity cultch plant is buried under 3" or more of sediment, and has shown near zero productivity in the last 3 years.

The Lake Chien cultch plants are located on the only suitable substrate in the area, and with their small size can only produce a relative amount of resource. The small size of the reef areas also allow for easy overharvest. Although Lake Chien has not been open for harvest since 2012, evidence of illegal harvest has been observed while conducting monthly dredge samples. Marker poles or buoys used by harvesters when oysters are found have been discovered on the cultch plants on more than one occasion while conducting monthly samples. A few cases of illegal harvest have been made by LDWF Enforcement in the past.

Spat Production

Average number of oyster spat ranged from 0 to 19/sample location in 2015 (Table 5.5). Lake Chien had the highest number per sample, with an average of 18.7 between the 2004 and 2009 cultch plants. All areas, except Lakes Felicity and Mechant, showed an increase in spat from last year's assessment.

Table 5.1 2015 Sister Lake oyster availability by sample station.

METER² STATION NEW#(OLD#)	REEF ACREAGE	#METER²	#SEED OYSTERS	#SACK OYSTERS	BARRELS SEED OYSTERS	BARRELS SACK OYSTERS	OYSTER SPAT/m^2
3020 (200)*	320.31	1,296,252.93	1.47	0.87	2,640.52	3,120.61	1.10
3028 (203)	140.43	568,301.95	0.00	0.60	0.00	947.17	0.40
3015 (207)	55.77	225,693.94	14.00	3.80	4,388.49	2,382.32	2.60
3021 (213)	191.04	773,114.04	0.00	0.20	0.00	429.51	0
3022 (214)	552.44	2,235,652.86	0.00	0.00	0.00	0.00	0
3023 (215)	512.79	2,075,194.47	0.00	0.00	0.00	0.00	0
3026 (218)	82.26	332,895.53	20.20	1.60	9,339.57	1,479.54	17.8
3042 (219)	155.52	629,369.22	0.00	0.20	0.00	349.65	0
2012 CP	364.80	1,476,298.18	60.80	12.00	124,665.18	49,209.94	8.80
TOTAL	2,375.36	9,612,773.12	96.47	19.27	141,033.76	57,918.74	

* Average of stations 3020 (200), 3010 (202), and 3024 (216) to represent the Grand Pass reef complex.

Table 5.2 2015 Bay Junop Oyster Availability

METER² STATION NEW#(OLD#)	REEF ACREAGE	#METER²	#SEED OYSTERS	#SACK OYSTERS	BARRELS SEED OYSTERS	BARRELS SACK OYSTERS	OYSTER SPAT/m^2
3038 (251)	17.20	69,606.16	0.00	0.40	0.00	77.34	0
3035 (252)*	67.36	272,597.16	0.40	0.60	151.44	454.33	3.70
3036 (253)	73.26	296,473.70	0.40	0.20	164.71	164.71	8.20
TOTAL	157.82	638,677.02	0.80	1.20	316.15	696.38	

* Average of stations 3035 (252) and 3037 (255) to represent the South Bay Junop reef complex.

Table 5.3 2015 Lake Mechant/Lake Chien/Lake Felicity Oyster Availability

METER² STATION (#)	REEF ACREAGE	#METER²	#SEED OYSTERS	#SACK OYSTERS	BARRELS SEED OYSTERS	BARRELS SACK OYSTERS	OYSTER SPAT/m^2
Lake Mechant (3029)	30.0	121,406.10	3.40	0.00	573.31	0.00	2.00
Lake Felicity (3039)	40.0	161,880.00	0	0	0	0	0
Lake Chien 2004 (3040)	16.0	64,749.92	5.4	0.6	485.6	107.9	18.4
Lake Chien 2009 (3041)	22.3	90,248.10	7.0	2.40	877.38	601.64	19.0
TOTAL	107.8	436,262.70	15.8	3.0	1,936.2	709.6	

Table 5.4 Oyster availability and percent change from the 2014 to 2015 assessment for both regions of Coastal Study Area (CSA) 5.

		Barrels of Seed Oysters			Barrels of Sack Oysters		
Region	Area	2014	2015	*Change*	2014	2015	*Change*
Western TB	Sister Lake	269,893.01	141,033.76	-47.7%	33,550.98	57,918.74	72.6%
	Bay Junop	2,093.18	316.15	-84.9%	3,283.68	696.38	-78.8%
	Lake Mechant	2,866.53	573.31	-80%	0	0	0
Eastern TB	Lake Chien	2,064.08	1,363.1	-34%	254.96	709.6	178.3%
	Lake Felicity	89.90	0	-100%	0	0	0

Table 5.5 Average oyster spat per square-meter sample for the 2014 and 2015 assessment, for all areas within Coastal Study Area 5. (TB= Terrebonne Basin).

		Oyster Spat/m^2	
Region	Area	*2014*	*2015*
Western TB	Sister Lake	0.1	2.4
	2012 Cultch Plant	2.4	8.8
	Bay Junop	0.1	3.9
	Lake Mechant	2.4	2.0
Eastern TB	Lake Chien	6.4	18.7
	Lake Felicity	1.2	0

Hydrological Data

Mean water temperatures, for May and June 2015, on each public oyster area ranged from 27.3 - 28.0 C^o and were below the long-term means. Mean salinities were also below average for all areas for the two months prior to sampling (Tables 5.6 and 5.7). Temperature and salinity measurements collected concurrently with the square-meter sampling in July averaged: 28.6 C^o and 13.0ppt in the eastern basin, 29.7 C^o and 4.4ppt in Sister Lake, 29.2 C^o and 6.8ppt in Bay Junop, and 30.0 C^o, 0.3ppt in Lake Mechant.

Table 5.6 Mean May-June and historic means (excluding 2015) of water temperature (°C) and salinity (ppt) from Sister Lake, Bay Junop, and Lake Mechant dredge samples (X= not designated as seed ground or reservation and, thus, no data were collected).

	TEMPERATURE			SALINITY		
YEAR	Sister Lake	Bay Junop	Lake Mechant	Sister Lake	Bay Junop	Lake Mechant
1996	29.4	29.3	X	17.2	18.2	X
1997	29.0	28.8	X	7.7	10.1	X
1998	29.0	28.8	X	10.5	8.6	X
1999	28.2	27.5	X	14.1	13.4	X
2000	29.6	29.2	X	24.9	23.8	X
2001	27.5	27.5	X	12.1	14.0	X
2002	28.4	27.9	X	11.0	11.4	X
2003	29.1	28.9	X	7.5	9.2	X
2004	29.4	28.7	X	14.1	17.2	X
2005	28.3	27.9	X	16.1	19.0	X
2006	28.1	26.1	X	22.7	20.4	X
2007	27.6	27.5	27.8	19.3	20.0	11.5
2008	26.7	28.1	28.1	6.2	6.9	0.4
2009	29.5	29.1	28.6	10.3	12.0	2.6
2010	29.8	28.3	28.9	17.8	15.4	15.1
2011	26.4	26.5	25.7	16.1	16.1	5.5
2012	29.3	29.3	29.0	16.5	17.7	9.4
2013	28.1	27.8	27.8	9.3	11.0	1.9
2014	28.1	27.7	27.5	15.4	16.3	6.5
2015	27.8	28.0	27.6	7.6	7.7	0.9
Mean	28.5	28.2	27.9	14.1	14.8	6.6

Table 5.7 Mean May-June and historic means (excluding 2015) of water temperature (^oC) and salinity (ppt) from Lake Felicity and Lake Chien dredge samples.

YEAR	TEMPERATURE		SALINITY	
	Felicity	Chien	Felicity	Chien
2006	27.6	27.8	24.9	25.0
2007	27.4	27.6	20.9	20.7
2008	28.2	28.6	16.0	16.0
2009	28.3	28.6	21.3	21.1
2010	29.2	29.5	18.6	17.8
2011	27.2	27.5	25.0	24.9
2012	29.0	29.0	20.0	19.2
2013	25.2	25.3	15.0	13.6
2014	26.2	26.5	19.8	18.3
2015	27.3	27.6	14.9	14.1
Mean	27.6	27.8	20.2	19.6

Mortality

There were no areas where recent mortality of sack oysters was observed in the 2015 square meter samples for Terrebonne Basin (Table 5.8). Spat and seed oyster mortality was observed only in the western part of the basin, and Lake Mechant showed the highest rate for both.

Table 5.8 Overall percent mortalities of spat, seed and sack oysters in 2015 for all areas within Coastal Study Area (CSA) 5.

Region	Area	Spat	Seed	Sack
Western TB	Sister Lake	0.4	0.4	0
	Bay Junop	2.2	0	0
	Lake Mechant	9.1	10.5	0
Eastern TB	Lake Felicity	0	0	0
	Lake Chien	0	0	0

Fouling Organisms / Predators / Disease

Four incidental species (hooked mussel, mud crab, oyster drill, and stone crab) were collected in square meter samples (Table 5.9). Hooked mussels were the incidental species most abundant and were more prevalent in the western TB samples, having an overall average of 5.7/sample. Of this overall average, Sister Lake had the highest occurrence with 8.2/sample; Eastern TB samples showed an average of 0.07/sample.

Table 5.9 Average numbers of hooked mussels, oyster drills, and select crab species per sample by seed ground or reservation and overall (TB=Terrebonne Basin).

Region	Seed Ground	Numbers Per Sample				
		Hooked Mussels	Mud Crab	Oyster Drill	Stone Crab	Blue Crab
Western TB	Sister Lake	8.2	0.9	0	0	0
	Bay Junop	1.2	0.7	0	0	0
	Lake Mechant	7.4	0.4	0	0	0
	Overall	5.7	0.7	0	0	0
Eastern TB	Lake Felicity	0	0	0	0	0
	Lake Chien	0.1	0.2	0.2	0.1	0
	Overall	0.07	0.13	0.13	0.07	0

Scientific literature suggests that Dermo (*Perkinsus marinus*) may cause extensive oyster mortalities in conditions of high salinities and water temperatures. Oysters from the Terrebonne Basin public oyster areas were collected and provided to Dr. Tom Soniat at the University of New Orleans for Dermo analysis.

Tropical Weather / Flooding Events

Tropical Storm Bill made landfall near Galveston, Texas on June 16, 2015. Higher than normal tides were experienced in the Terrebonne Basin while the low pressure system was in the Gulf of Mexico, but there were no impacts to the seed grounds and reservations.

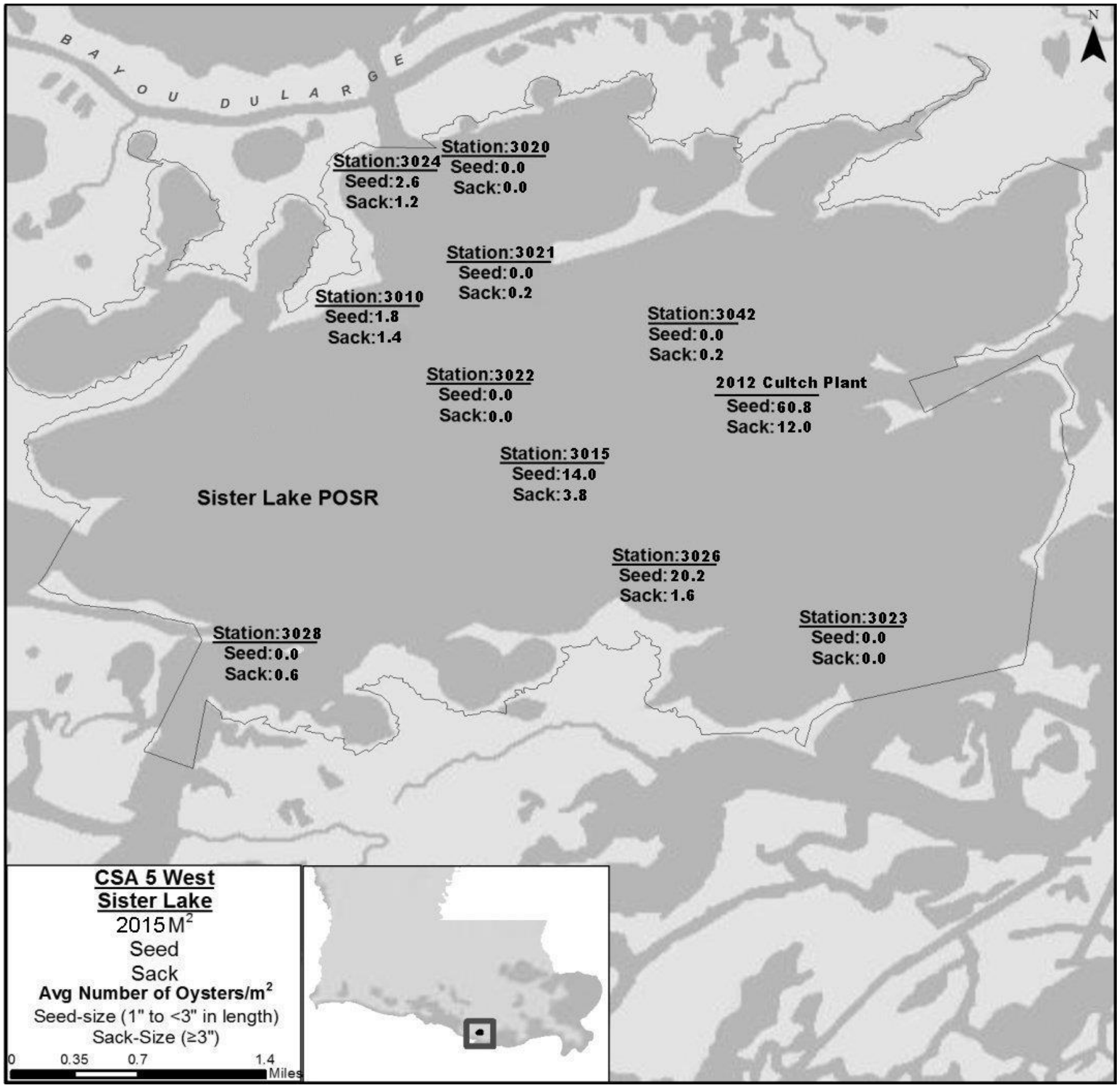

Figure 5.3 Results from each square-meter sampling station within Sister Lake.

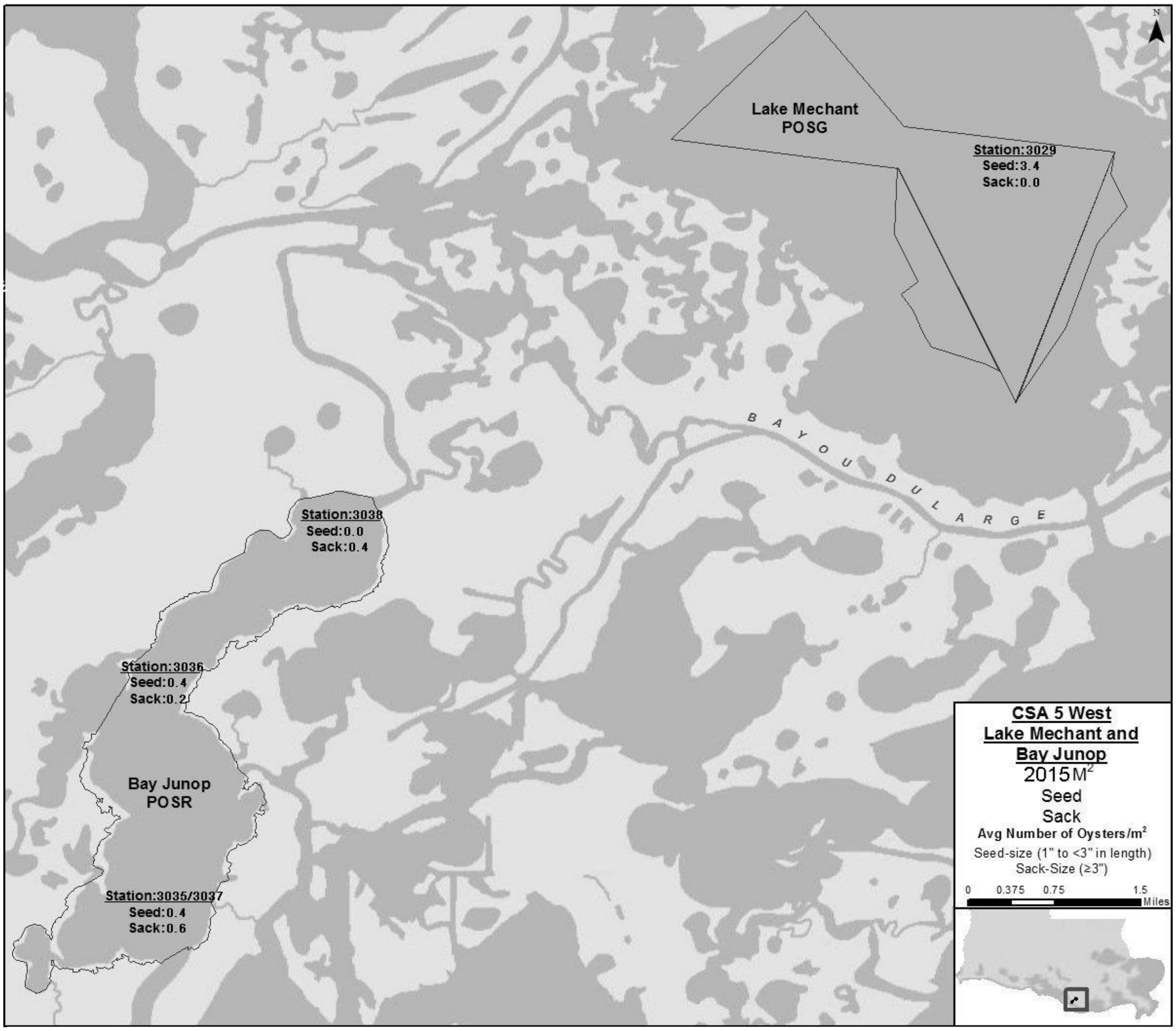

Figure 5.4 Results from square-meter sampling stations within Bay Junop and Lake Mechant.

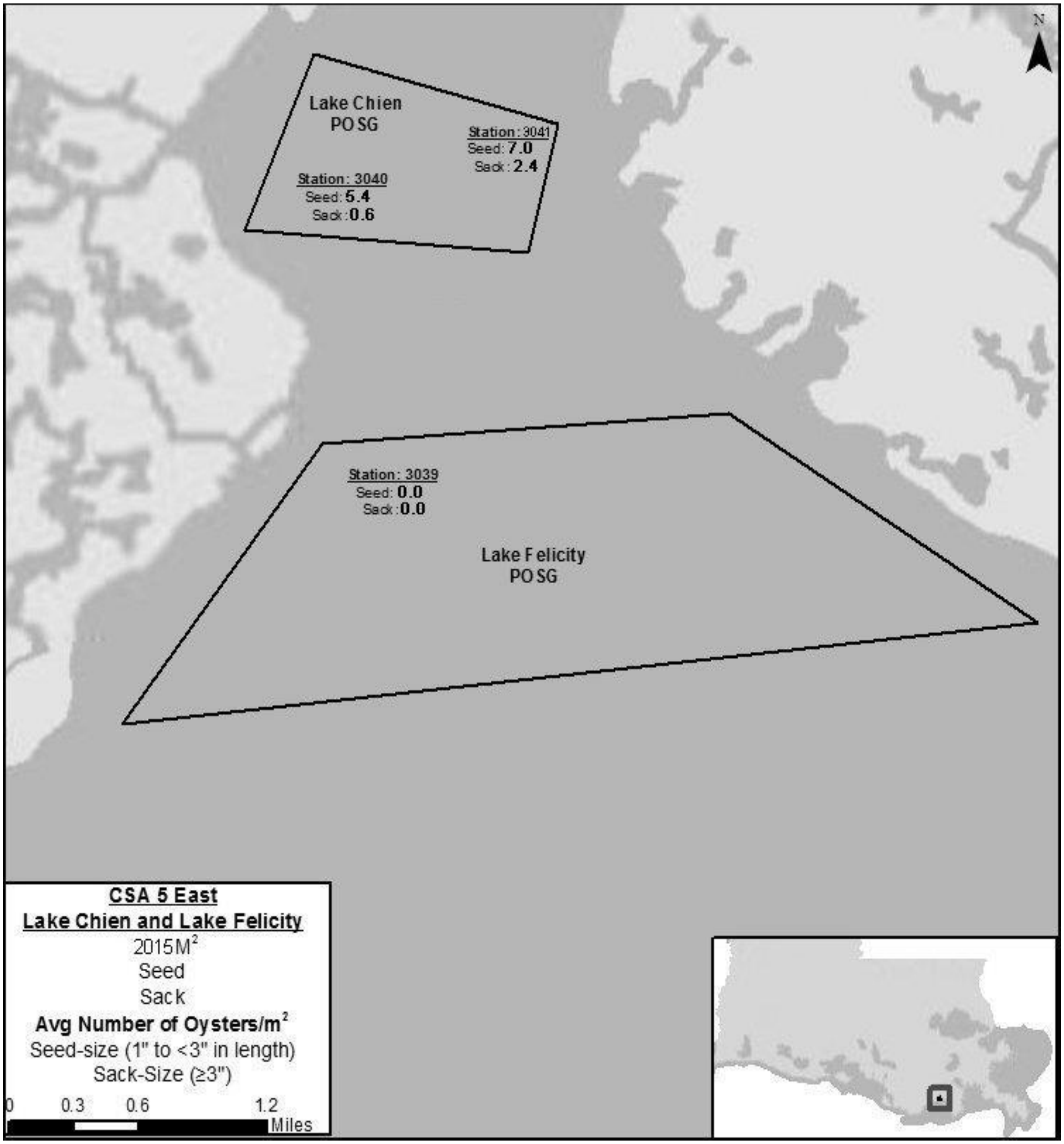

Figure 5.5 Results from square-meter sampling stations within Lake Chien and Lake Felicity.

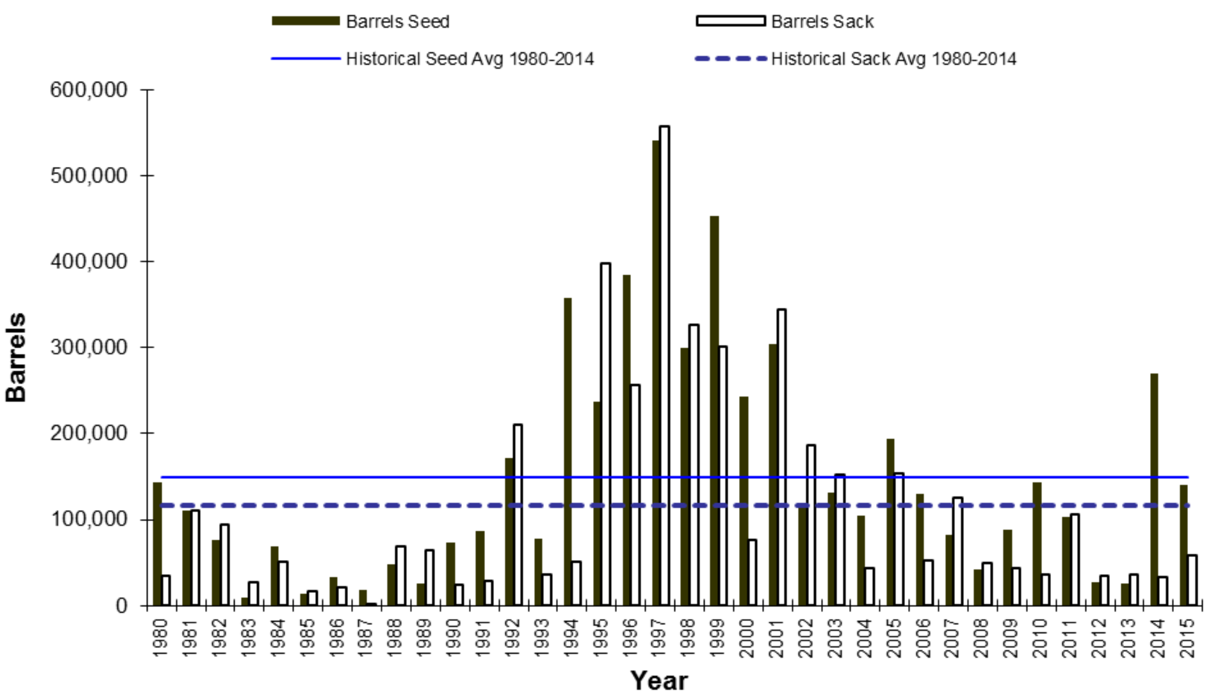

Figure 5.6 Sister Lake historic oyster stock availability.

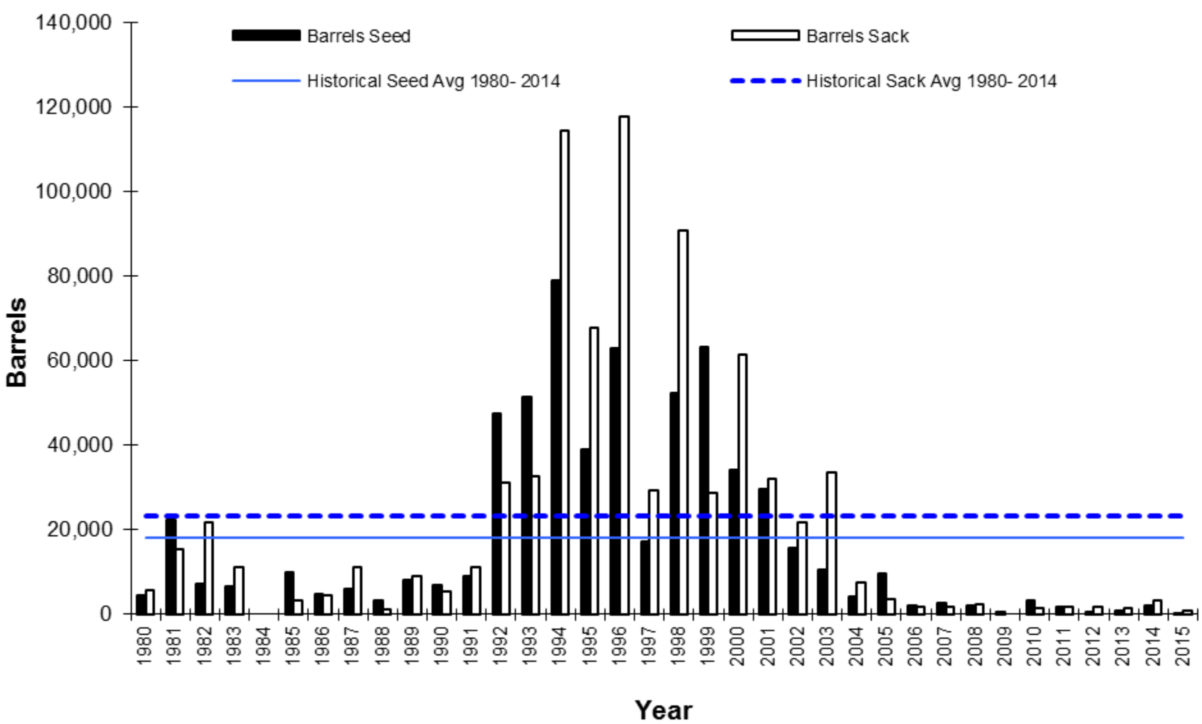

Figure 5.7 Bay Junop historic oyster stock availability.

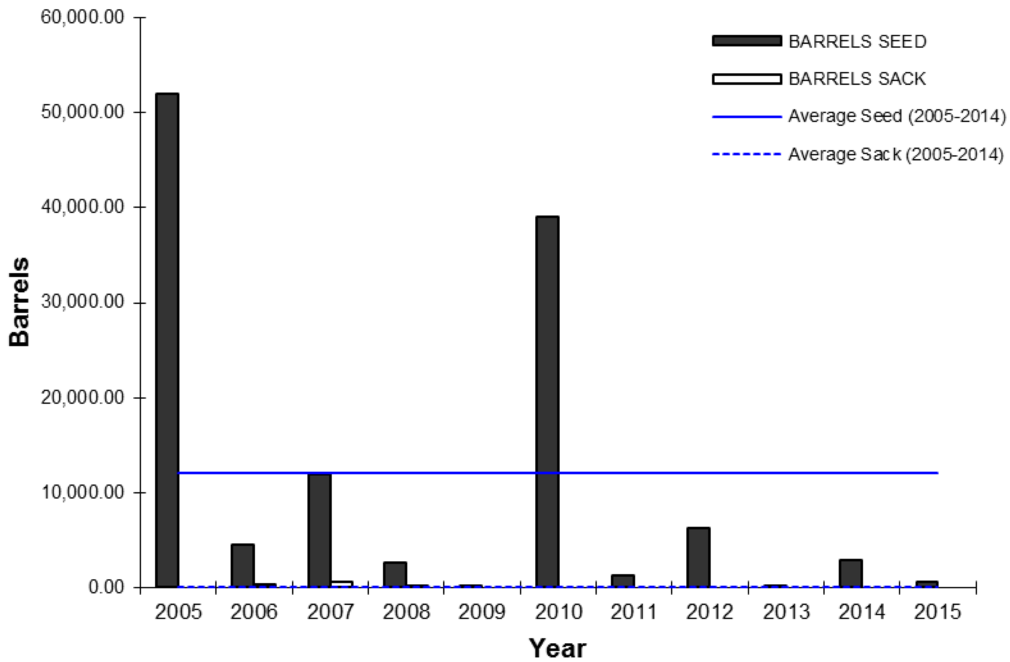

Figure 5.8 Lake Mechant historic oyster stock availability.

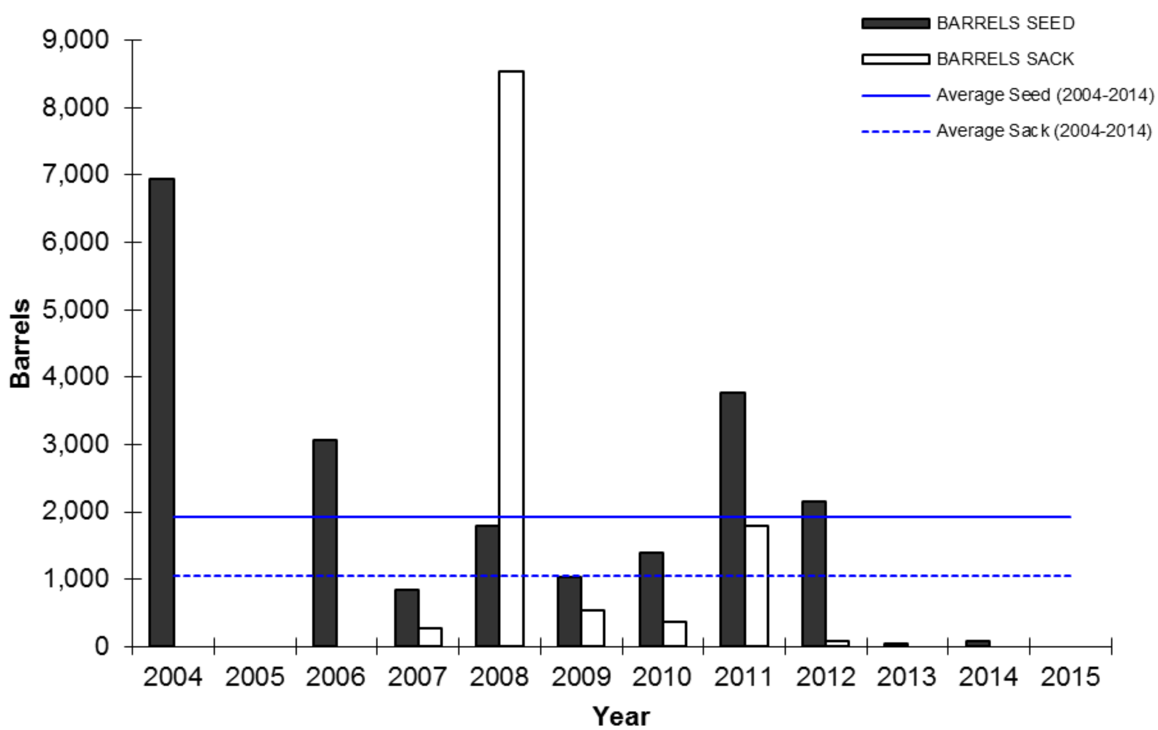

Figure 5.9 Lake Felicity historic oyster stock availability.

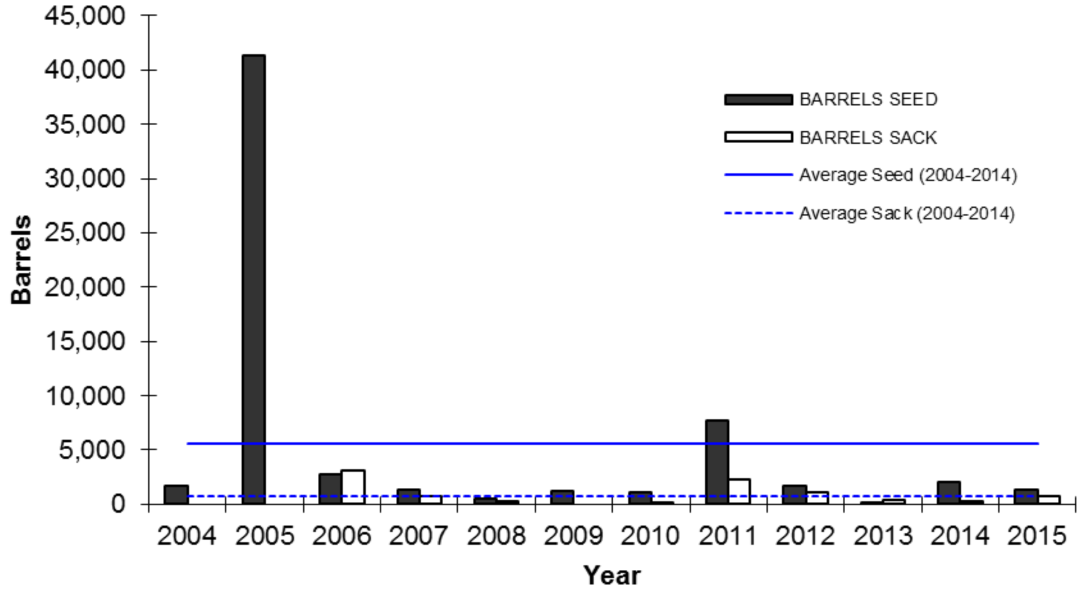

Figure 5.10 Lake Chien historic oyster availability.

<u>2014/2015 Oyster Season Summary</u>

Oyster harvests on the POSGs and POSRs were monitored through boarding reports. These data were used to calculate annual estimates for each public oyster area (Tables 5.10 and 5.11).

Sister Lake: The Sister Lake POSR was closed for the 2014 – 2015 season, and no legal harvest was documented. Unfortunately, a number of cases of illegal harvest from Sister Lake were made by LDWF Enforcement over the past year. Although oysters were returned to the water in these instances, it is highly likely that additional illegal harvest occurred which was not captured by LDWF Enforcement.

Lake Mechant: Lake Mechant opened on October 20, 2014 with a 40-sack per vessel limit and was open until the Department of Health and Hospitals (DHH) implemented a seasonal public health closure on November 1, 2014. Total fishing effort was 63 vessel-days, of which 55 vessel-days were for the harvest of market oysters and 8 for the harvest of seed oysters. Total estimated harvest was 1,490 sacks of market oysters and 1,175 barrels of seed oysters based on boarding reports.

Bay Junop: Bay Junop opened on October 20, 2014 with a 40-sack per vessel limit. The majority of the bay was excluded from oyster harvest on November 1, 2014 when the Department of Health and Hospitals (DHH) implemented a seasonal public health closure. Total fishing effort was 92 vessel-days, all of which were for the harvest of market oysters. Total estimated harvest was 2,347 sacks of market oysters based on boarding reports.

Lake Chien / Lake Felicity: Lakes Chien and Felicity were closed for the 2014 – 2015 season, and no harvest was documented via LDWF boarding runs.

Lake Mechant was the only area in the Terrebonne Basin where seed sized oysters was harvested during the 2014 season. Six samples were collected from three bedding vessels in Lake Mechant to determine the percent cultch in seed stock harvested. Percentages of cultch taken from Lake Mechant ranged from 4 - 76% and had an overall average cultch take of 41% per bedding load.

Table 5.10 Annual totals and long-term means (excluding 2014) of commercial seed oyster (barrels) and sack oyster (sacks) harvests from Sister Lake, Lake Mechant, and Bay Junop (NS=no season; X=not designated as seed ground or reservation).

YEAR	SISTER LAKE		BAY JUNOP		LAKE MECHANT	
	Seed	Sack	Seed	Sack	Seed	Sack
1995	51,160	48,824	NS	NS	X	X
1996	20,055	40,019	3,770	26,908	X	X
1997	31,668	43,727	NS	NS	X	X
1998	15,228	16,510	6,205	20,345	X	X
1999	29,934	47,586	NS	NS	X	X
2000	NS	NS	NS	NS	X	X
2001	18,183	34,060	NS	NS	X	X
2002	NS	NS	40	1,031	X	X
2003	11,840	92,580	NS	NS	X	X
2004	NS	NS	5	2,623	0	2,211
2005	3,200	81,788	NS	NS	NS	NS
2006	NS	NS	10	3,890	NS	NS
2007	16,960	42,514	NS	NS	19,665	13,703
2008	600	5,530	0	737	NS	NS
2009	4,610	13,676	NS	NS	NS	NS
2010	NS	NS	0	433	0	91
2011	15,765	86,812	0	100	0	0
2012	NS	NS	0	1,163	1,075	2,243
2013	7,315	86,804	NS	NS	3,390	706
2014	NS	NS	0	2,347	1,175	1,490
MEAN	17,424	49,264	1,114	6,359	4,022	3,159

Table 5.11 Annual totals and long term means of seed oyster (barrels) and sack oyster (sacks) harvests from Lake Felicity and Lake Chien cultch plants (NS=no season).

YEAR	LAKE FELICITY		LAKE CHIEN TOTAL	
	Seed	Sack	Seed	Sack
2005	15	0	253	0
2006	0	0	1,940	0
2007	470	4,830	2,157	2,439
2008	0	0	205	17
2009	NS	NS	NS	NS
2010	0	205	0	405
2011	671	351	156	2,458
2012	0	37	0	1022
2013	NS	NS	NS	NS
2014	NS	NS	NS	NS
MEAN	165	775	673	906

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Vermilion Basin (CSA6) – 2015 Oyster Stock Assessment

Introduction

Oyster reefs found in the Vermilion/East and West Cote Blanche/Atchafalaya Public Oyster Seed Grounds generally fall within the boundaries of Coastal Study Area 6 (CSA6). The inside oyster seed ground, promulgated by the Louisiana Wildlife and Fisheries Commission in 1990, consists of that portion of state water bottoms found generally north of a line from the western shore of Vermilion Bay and Southwest Pass eastward to Point Au Fer. The outside area, designated in 1988, consists of Louisiana State Territorial Waters from the private oyster lease boundary near Mound Point/Marsh Island eastward to Point Au Fer. Since 1986 (prior to the official designation of these areas as seed grounds), LDWF managed the oyster resources found on local state water bottoms in a manner similar to present seed grounds management procedures. This allowed limited harvest/relays from the Vermilion Bay area reefs when oyster abundance and distribution permitted.

The Vermilion/Cote Blanche/Atchafalaya Bays Complex is a large, primarily open-water brackish system with the public oyster seed grounds consisting of approximately 541,787 water bottom acres. Primary influences on the bays dynamic salinity regime are the Gulf of Mexico, Atchafalaya River and the adjacent Wax Lake Outlet, and the Vermilion River. In general, the public oyster seed grounds within CSA 6 are highly influenced by freshwater discharge from the Atchafalaya River. Typically, oyster reproduction occurs in the fall after the river stage abates, with oysters growing to seed size (1 inch to < 3 inches) by the following spring. However, spring and early summer floodwaters depress salinities, placing extreme physiological stress on the organisms. These low salinities, coupled with high water temperatures through the summer months, typically result in extensive oyster mortalities on the public grounds. Occasionally, however, reduced freshwater inflow from the Atchafalaya River leads to higher-than-normal salinities and the normal annual cycle of extensive oyster mortalities is broken, leading to a harvestable population of seed oysters during the following oyster season (September through April). Such was the case in 2000, 2001, 2005, 2006, 2007, 2013, and 2014 when sizeable quantities of seed oysters were available for harvest.

An overall Vermilion Bay area stock assessment is not possible at this time, as figures relative to oyster reef sizes are not available. However, data collected from this year's sampling program will be compared to previous years' data, with a look at hydrologic conditions, marine fouling, and oyster predators on sampled reefs. In addition, information regarding the 2014/2015 oyster season harvest on the Vermilion Bay area public oyster seed grounds will be presented.

Methods

Field sampling was conducted on July 22, 2015. A total of eleven stations (Figures 6.1 and 6.2) were sampled with five replicate quadrat samples collected at each station, characterizing the spatial distribution of sampling effort on the hard-bottom areas found within the system. The square meter and dredge sampling programs were expanded in January, 2015 to include a site at Nickle Reef, a natural oyster reef found approximately five miles southeast of South Point, Marsh Island. Upon reaching the designated site, the square meter frame was randomly thrown onto the oyster reef. A SCUBA diver removed all oysters, associated macroscopic organisms, and loose surface shell within the frame. All live oysters, and shells from recently dead oysters, were counted, measured in five millimeter (mm) intervals, then classified as spat (<25 mm), seed (25 mm to < 75mm), or sack oysters (≥75mm). Shells from recently dead oysters were defined as "box" (both valves attached) or "valve" (one valve). Oyster size was determined by measuring the "straight-line" distance from the hinge to the apex of the shell. Live predators and fouling organisms were counted. Cultch type and reef condition were noted. Water temperature and salinity data were collected in conjunction with square meter oyster samples.

Results and Discussion

Seed and Sack Stock

Live seed oysters were found at three of the eleven sample sites. Density numbers at the sites with live seed ranged from 0.4 per replicate at North Reef to a high of 3.4 at Nickle Reef (Figures 6.1 and 6.2). No sack size oysters were collected at any site.

Low production years associated with extended periods of high Atchafalaya River output are not uncommon on the seed grounds of this bay system. Near 100% oyster mortality on the grounds was noted in seven of the previous ten years and is reflected by the results of the annual oyster stock assessment data (Figure 6.3).

Spat Production

Despite the presence of suitable substrate at all locations, live spat were found at only 5 of the eleven sample sites (Figures 6.1 and 6.2). Density numbers at the sites with spat ranged from 0.2 to a high of 2.6 per replicate at Nickle Reef. Low spat productivity during periods of high Atchafalaya River flow (with associated low salinity conditions) are common in this bay system.

Fouling organisms

An overall increase of 23% in hooked mussel (*Ischadium recurvum*) abundance on the seed grounds compared to last year's assessment was documented. An increase in numbers was noted at six of the stations while density decreased at the remaining historic sites. The Nickle Reef station's initial density was 0.6 mussels per replicate (Table 6.1).

Oyster Predators

Only one southern oyster drill (*Stramonita haemastoma*) was collected during square meter sampling, with that specimen found at Nickle Reef (this site had the highest monthly salinity recorded for all stations monitored following last year's stock assessment). These predatory marine snails are more often associated with high salinity waters where they are known to prey heavily on oysters and other bivalve species. An overall decrease of 20% in mud crab *(Xanthidae sp.)* occurrence on historically sampled reefs was observed compared to the previous year's assessment. While five of the eleven sites had no mud crabs, density reached a high of 2.4 crabs per replicate at Lighthouse Point (the new Nickle Reef site had a density of 1.2 mud crabs per replicate). No blue crabs *(Callinectes sapidus)* or stone crabs *(Menippe adinia)* were collected during the 2015 square meter survey.

Dermo

Dermo (*Perkinsus marinus*), a protozoan parasite prevalent in oysters, may cause extensive mortalities in conditions of high salinities and water temperatures. As in previous years, an attempt to collect samples from the eastern and western part of the system for analysis of the presence of this pathogen was made. An oyster dredge was used to collect a sufficient number of seed and sack-sized oysters from the Lighthouse Point (west) and Nickle Reef (east) sites. All samples were forwarded to Dr. Tom Soniat (University of New Orleans) for quantification of the protozoan infestation. Results of Dermo analysis are contained within a separate section of this document.

Mortality
Following the July 2014 square meter stock assessment, August and September dredge samples found promising numbers of spat, seed, and sack size oysters at both eastern and western sites. A positive spat set throughout the system was documented in August and September, with favorable hydrologic conditions recorded at all stations. Salinity levels remained relatively high through the year's end, with the river level as recorded at the Butte LaRose gauge remaining below twelve feet until March of 2015. In April the river rose to sixteen feet and salinity levels throughout the system fell significantly, reaching a low of 0.1 ppt. at the North Reef site (east) and 0.9 ppt. at Lighthouse Point (west). Mortality in western sites reached as high as 95% and 100% at the Indian Point and Big Charles sites respectively. Eastern offshore samples (Middle Reef and Nickle Reef) saw little negative impact while significant mortality was recorded at sites further inshore (North Reef had 73% recent mortality in the June 2015 dredge samples). Salinity levels rose significantly throughout the system in July, with a high of 28.2 ppt. recorded at the Indian Point site during square meter sampling.

The oyster resource found in the area is highly vulnerable to low salinity/high turbidity conditions often seen as a result of extended freshwater conditions associated with high Atchafalaya River discharge. Independent of local rainfall, a historic negative correlation between increased Atchafalaya River flow and reduced salinity levels in the Bays system has been noted. This year's stock assessment hydrology graph (Figure 6.4) follows that general correlation until July 2015 when southwest winds became predominant and blew consistently throughout the month. An uncharacteristic increase in river flow during July (from an already high level for that time of year) was documented with no corresponding fall in salinity. Instead, a dramatic increase in salinity was recorded at Cypremort Point for the month of July.

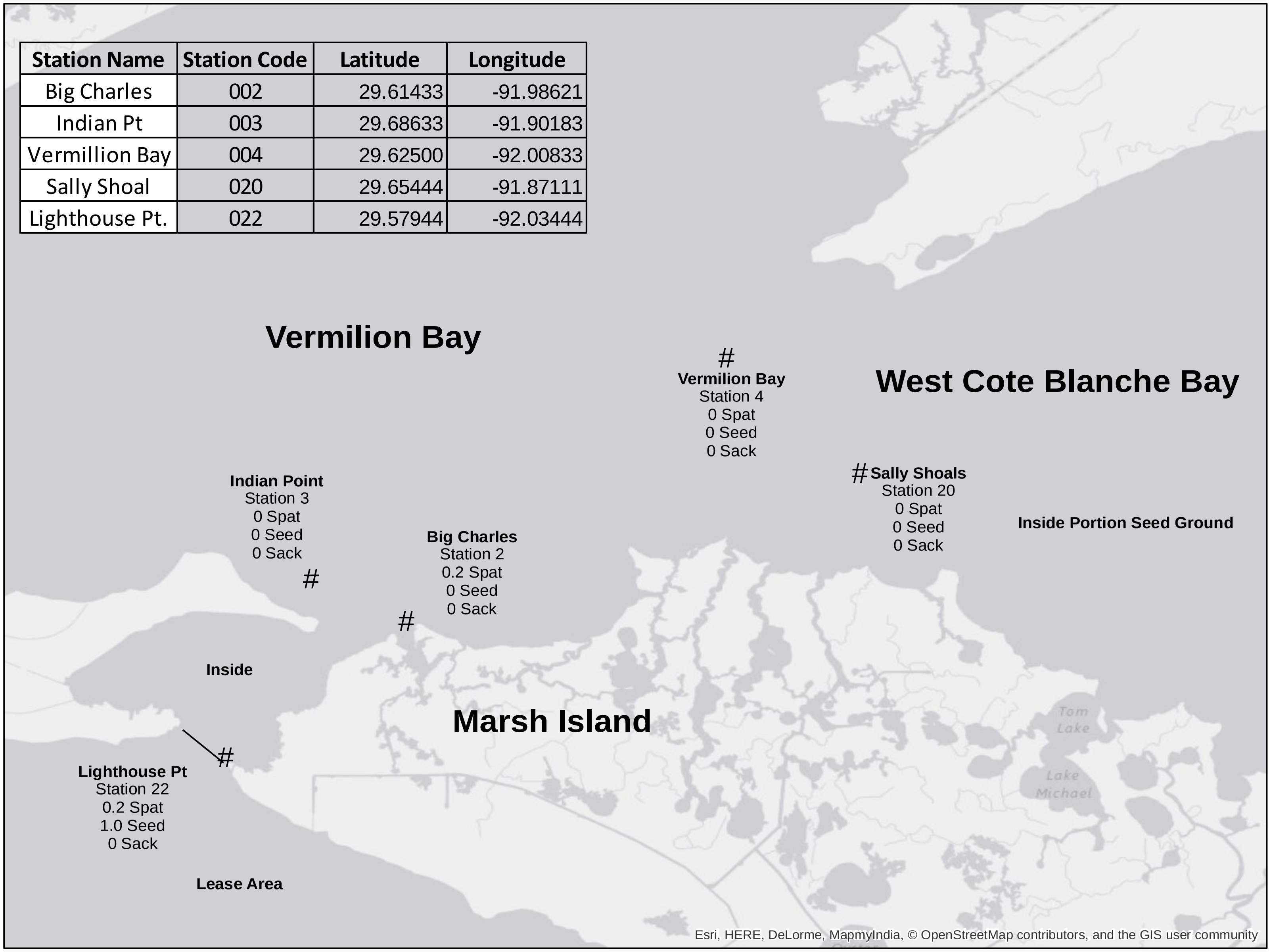
Tropical and Climatic Events
Tropical Storm Bill formed in the Gulf of Mexico and eventually made landfall at Matagorda Island, Texas on June 16, 2015, bringing heavy rains to Texas and western Louisiana. High wind and seas were observed in coastal CSA 6 waters, precluding oyster fishing activity on nearby leases for several days.

<u>2014/2015 Oyster Season Summary</u>
Methods
Roving surveys on portions of the seed grounds with "OPEN" designation under DHH's classification system and areas under DHH relay permit are made to obtain fishery dependent data (i.e. harvest estimates). Fishermen working the seed ground are surveyed and asked to provide estimates of past and current catch rates as well as an estimate of future fishing effort. The data was summarized weekly to maintain a cumulative estimate of harvest for specific reef complexes. Trip ticket data was also analyzed to provide additional harvest information.

Results & Discussion

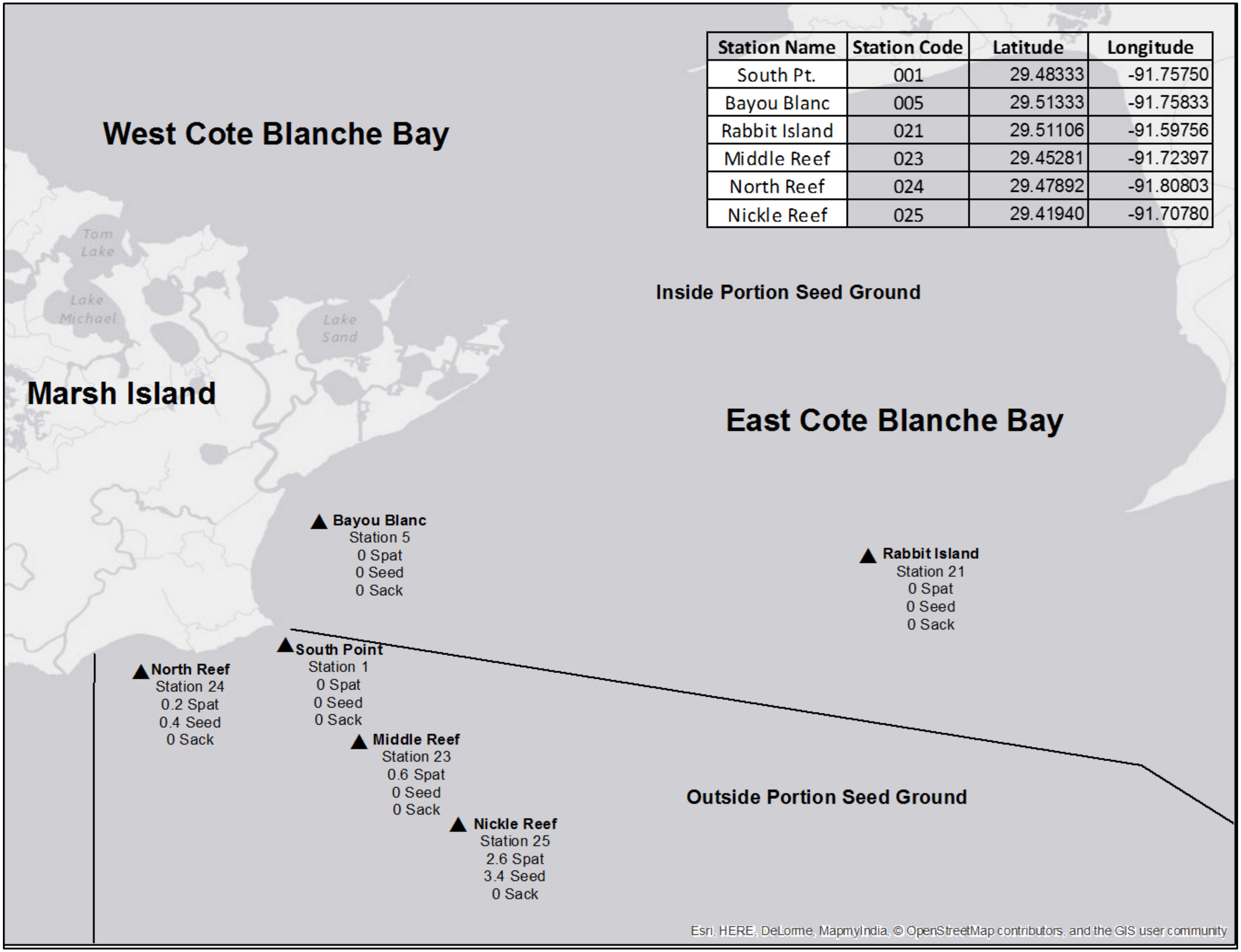
The Vermilion/East and West Cote Blanche/Atchafalaya Bay Public Oyster Seed Grounds opened one-half hour before sunrise on September 3, 2014 for the harvest of seed oysters. Harvest of oysters for market sales was allowed beginning October 12, 2014 with a 50-sack daily and possession limit per vessel. The season remained open until one-half hour after sunset on April 30, 2015..

For the first time in many years, Harvest Area 25 (Point Au Fer west to Mound Pt., Marsh Island) was opened by DHH for harvest during the 2014/2015 oyster season based on improved water quality in the area. An estimated 30,051 sacks of market-size oysters were harvested and an estimated 19,905 barrels of seed oysters were transplanted from reefs on the public seed ground in both eastern and western parts of the system, with primary effort concentrated in the eastern offshore area around Nickle Reef.



Station Name	Station Code	Latitude	Longitude
Big Charles	002	29.61433	-91.98621
Indian Pt	003	29.68633	-91.90183
Vermillion Bay	004	29.62500	-92.00833
Sally Shoal	020	29.65444	-91.87111
Lighthouse Pt.	022	29.57944	-92.03444

Figure 6.1 Map designating CSA6 2015 oyster square meter sample stations in the western part of the Vermilion, East and West Cote Blanche and Atchafalaya Bays public oyster seed ground. Data displayed below station numbers represent average spat, seed, and sack oysters per square meter sample.



Station Name	Station Code	Latitude	Longitude
South Pt.	001	29.48333	-91.75750
Bayou Blanc	005	29.51333	-91.75833
Rabbit Island	021	29.51106	-91.59756
Middle Reef	023	29.45281	-91.72397
North Reef	024	29.47892	-91.80803
Nickle Reef	025	29.41940	-91.70780

Figure 6.2 Map designating CSA6 2015 oyster square meter sample stations in the eastern part of the Vermilion, East and West Cote Blanche and Atchafalaya Bays public oyster seed ground. Data displayed below station numbers represent average spat, seed, and sack oysters per square meter sample.

Year	mean density seed/sample	mean density sack/sample	Seed/sack ratio
2000	81.4	3.3	24.7:1
2001	28.8	4.8	6.0:1
2002	2.25	0.25	9.0:1
2003	1.2	0	No Sack Oysters
2004	4.3	0	No Sack Oysters
2005	14.8	0	No Sack Oysters
2006	16.1	0.5	32.2:1
2007	11.6	0.8	14.5:1
2008	1.3	0	No Sack Oysters
2009	3.4	0	No Sack Oysters
2010	0.8	0.12	6.7:1
2011	0.32	0.02	16.0:1
2012	1.78	0.04	44.5:1
2013	0.3	0.02	15.0:1
2014	1.12	0.08	14:01
2015	0.44	0	No Sack Oysters

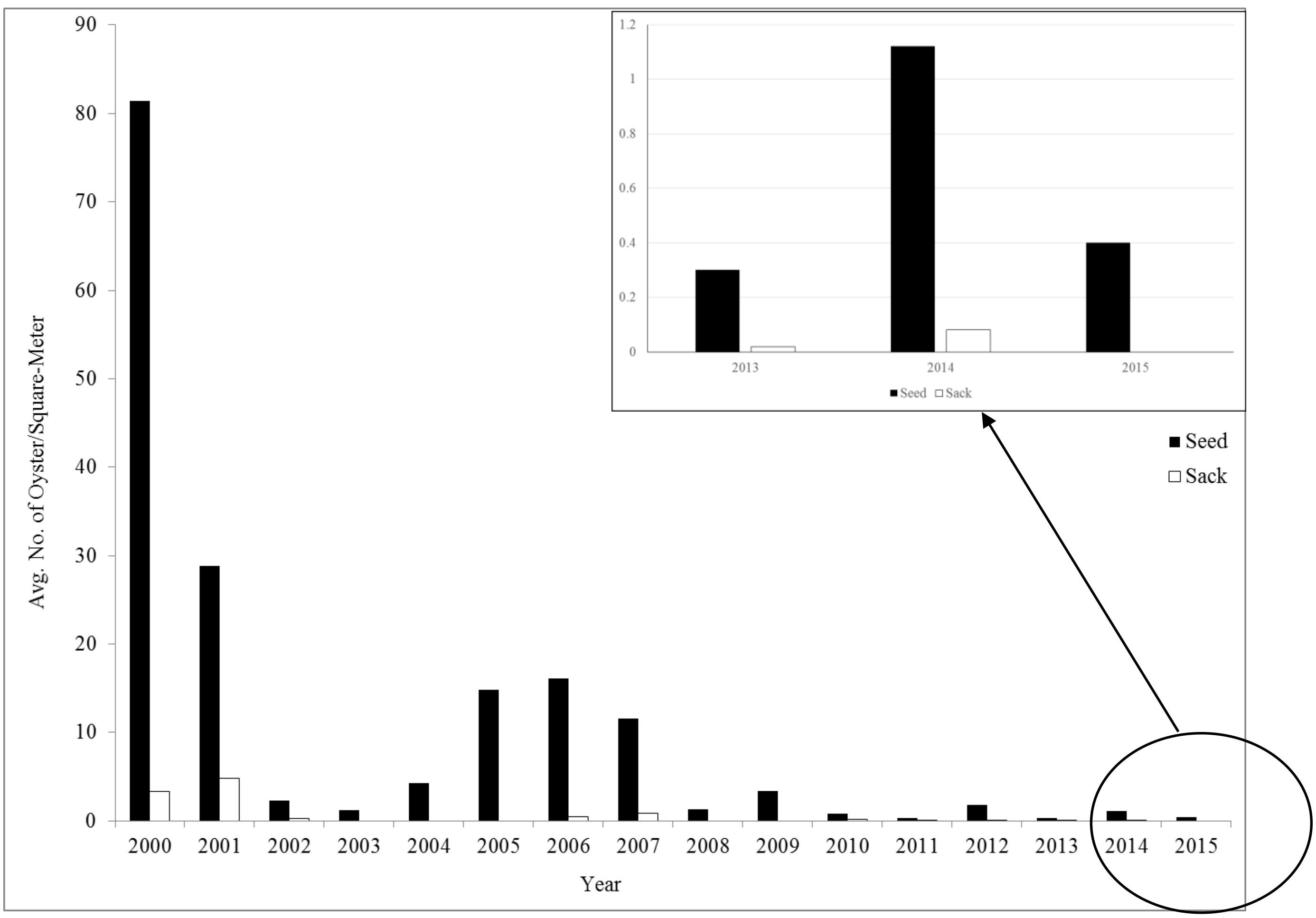


Figure 6.3. Graph depicting mean density of live seed and sack size oysters collected in CSA6 square meter samples (by year). Data table included.

Table 6.1. Mean density of the hooked mussel, *Ischadium recurvum*, recorded at each CSA6 square meter station (by year).
** 2011 was the first year for square meter samples for these stations*
***2015 was the first year for square meter samples for this station*

Station no.	Station name	2008	2009	2010	2011	2012	2013	2014	2015
001	South Pt./Marsh Island	1.0	0.0	11.2	1.4	46.4	0.0	2.6	6.0
002	Big Charles	2.5	0.0	18.4	5.2	21.2	4.8	1.0	6.2
003	Indian Point	0.5	16.0	18.2	20.4	16.6	5.4	8.0	1.0
004	Dry Reef/Vermilion Bay	2.0	37.0	0.0	6.6	29.8	38.2	25.2	12.6
005	Bayou Blanc	2.5	0.0	4.0	2.0	13.4	9.0	4.6	28.4
020*	Sally Shoals	*	*	*	3.8	25.2	4.8	12.4	5.6
021*	Rabbit Island	*	*	*	0.0	0.0	0.0	0.2	0.2
022*	Lighthouse Point	*	*	*	11.8	5.2	0.8	1.4	4.8
023*	Middle Reef	*	*	*	0.2	11.8	0.8	0.4	5.8
024*	North Reef	*	*	*	4.4	12.6	4.6	0	4.2
025**	Nickle Reef	**	**	**	**	**	**	**	0.6

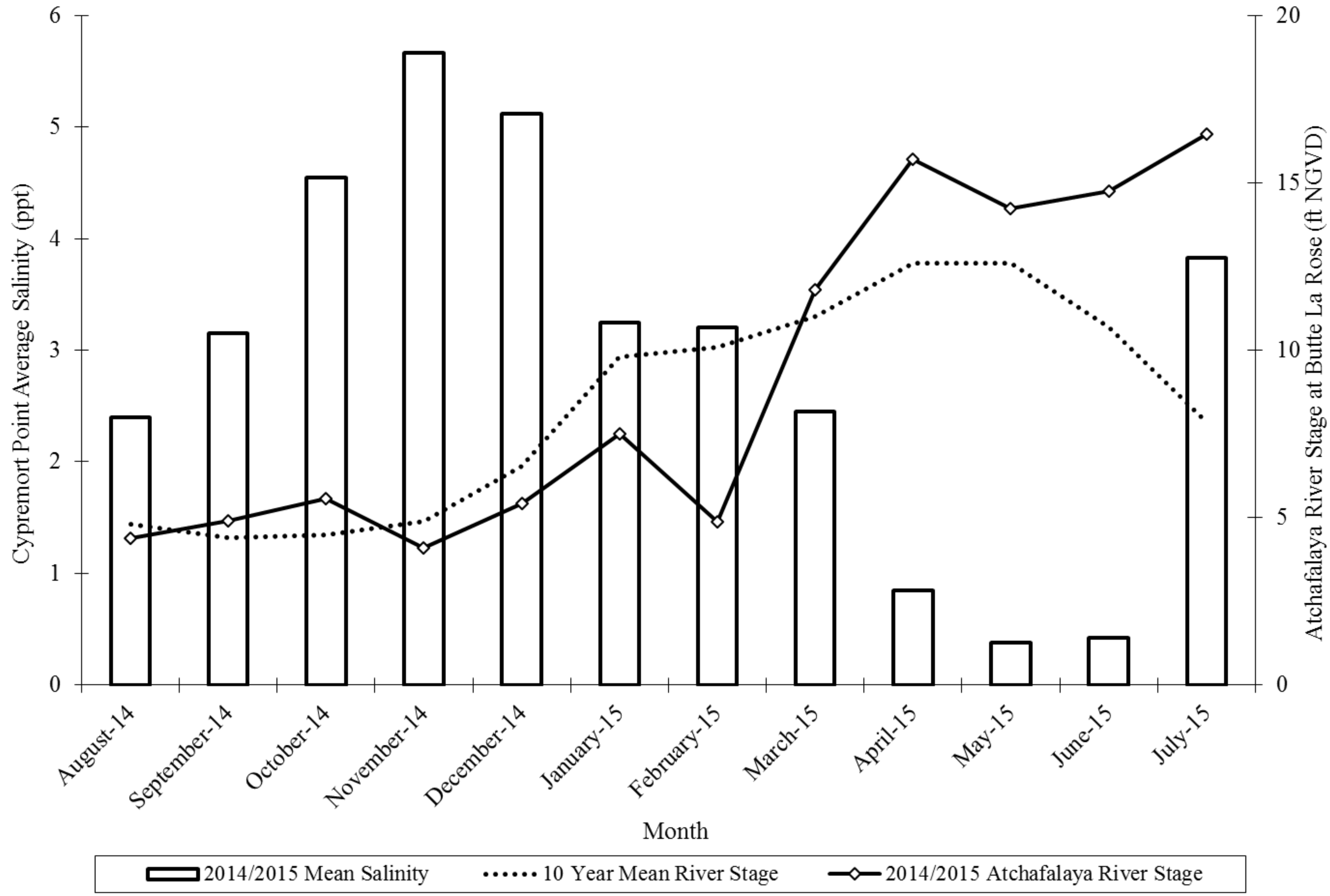


Figure 6.4. Graph depicting Atchafalaya River levels at Butte La Rose gauge and average salinity for Cypremort Point, LA during the period August 1, 2014 through July 31, 2015. Ten year average monthly river stage at Butte La Rose is included.

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Calcasieu/Sabine Basin (CSA7) – 2015 Oyster Stock Assessment

Introduction

Louisiana Department of Wildlife and Fisheries' (LDWF) Coastal Study Area VII is located in Southwest Louisiana, from the Louisiana/Texas state line to Freshwater Bayou in Vermilion Parish. It is comprised of Calcasieu and Mermentau River basins and the eastern portion of the Sabine River Basin. Calcasieu Lake is located at the southern end of the Calcasieu River basin in Calcasieu and Cameron parishes. It consists of approximately 58,260 water bottom acres with oyster reefs located throughout the lake, especially in the southern end. The Mermentau River basin has no oyster harvesting areas. Sabine Lake is located at the southern end of the Sabine River basin in Cameron parish. It consists of approximately 55,057 water bottom acres with approximately 34,067 acres in the Louisiana portion and the remainder in the Texas portion. Oyster reefs are located mainly in the very southern portion of the lake.

It is unclear when commercial oyster harvesting began on Calcasieu Lake and to what extent it took place. Early reports, however, from the Gulf Biologic Station near present-day Cameron, Louisiana documented that oyster harvest occurred south of the Lake in Calcasieu Pass as early as the summer of 1903. In 1967 Calcasieu Lake was closed to oyster harvesting and the closure remained until 1975 when oyster harvesting was reopened. Oyster harvesting resumed in 1975, but gear restrictions were placed on harvesting which allowed only taking by hand or tongs. The gear restriction remained in effect until 2004, when legislation (HB160; ACT479) was passed allowing for the use of hand oyster dredges of three feet wide or less in Calcasieu Lake. In 2006, legislation (HB802; ACT398) was passed allowing the use of mechanical retrieval systems for dredges. In 2011, legislation (SB73, ACT329) was passed restricting oyster harvest in Calcasieu Lake to those who possessed a Calcasieu Lake Oyster Harvest Permit. The number of permits granted was restricted to 126 oyster harvesters, of which 63 had to have historical oyster landings from Calcasieu Lake, with the remaining being first come first serve. In 2012, legislation (SB202, ACT541) removed the landings requirement as well as the restriction on the number of harvesters that could possess the permit.

Oyster seasons in Sabine Lake have not occurred since the early 1960's based on anecdotal information; neither Texas nor Louisiana can document harvest beyond that time and no concrete harvest data has been located.

For assessment purposes, Calcasieu Lake has always been divided into two areas – Eastside and West Cove (the Calcasieu Ship Channel being the dividing line). In 1992, Louisiana Department of Health and Hospitals (LDHH) also divided the lake into two separately managed shellfish harvest areas – Calcasieu Lake Conditional Managed Area (CLCMA) and West Cove Conditional Managed Area (WCCMA). Because the areas are classified as conditionally managed, LDHH has the authority to set closure regulations based on health related concerns due to poor water quality. Originally, LDHH established health related closures of oyster harvest in Calcasieu Lake based on the river stage of the Calcasieu River at Kinder, LA. CLCMA would be closed to oyster harvest when the river stage reached 12 feet and the WCCMA would close when the river stage reached 7 feet. Once the river fell below these levels for 48 hours the LDHH would reopen the areas for harvest. LDHH adjusted the CLCMA river stage threshold in 1998 to 13.5 feet. In 2004 LDHH reclassified the Louisiana Public Oyster Harvest Areas into Oyster

Growing Areas. The Eastside of Calcasieu Lake and West Cove are classified currently as Growing Area 29 (GA-29) and Growing Area 30 (GA-30) (Figure 7.1), respectively.

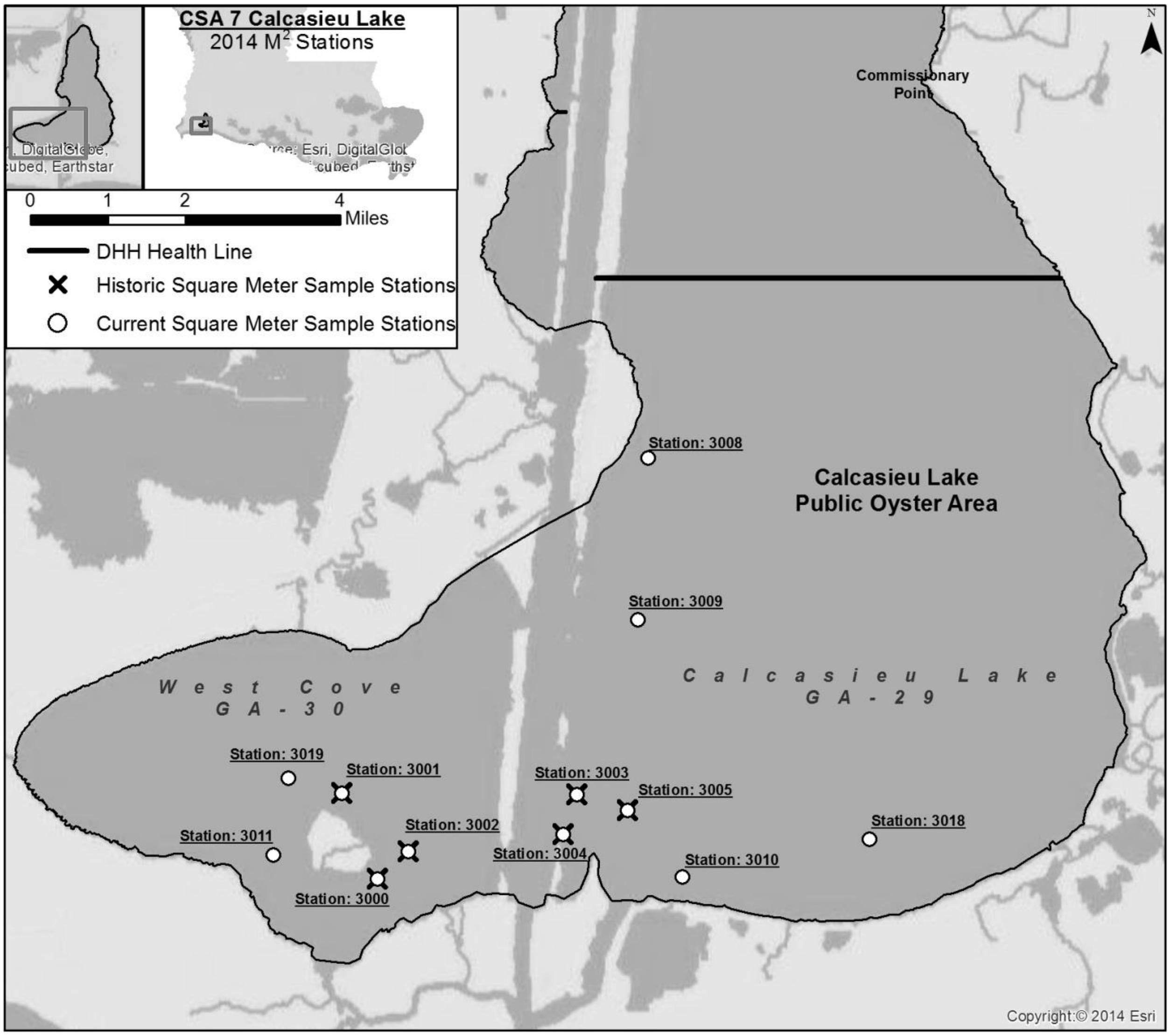

Figure 7.1. LDHH public oyster harvest areas (GA-29, GA-30) and LDWF meter square sampling station locations, Calcasieu Lake, Cameron Parish, Louisiana.

Prior to the start of the 2013-2014 oyster harvest season LDHH changed the Calcasieu River stage threshold for health related closures for GA-30 from 7ft. to 9ft. at Kinder.

LDHH also limited the amount of acreage available to oyster harvest on the Eastside due to water quality standards. Oysters can only be harvested in the southern portion of the area (GA29) where water quality meets minimum standards. The total area has been changed several times over the years with the current acreage being approximately 26,736 water bottom acres. GA30 has remained the same at approximately 9,248 acres of water bottom. The Louisiana portion of Sabine Lake (GA 31) has approximately 34,067 water bottom acres. This area was cleared by LDHH in March of 2011 for harvesting, but the Louisiana Wildlife and Fisheries Commission

(Commission) has not opened a harvest season on this area to date. Since it is cleared for harvesting by LDHH, LDWF has added the area to be assessed for oyster stocks (Figure 7.2).

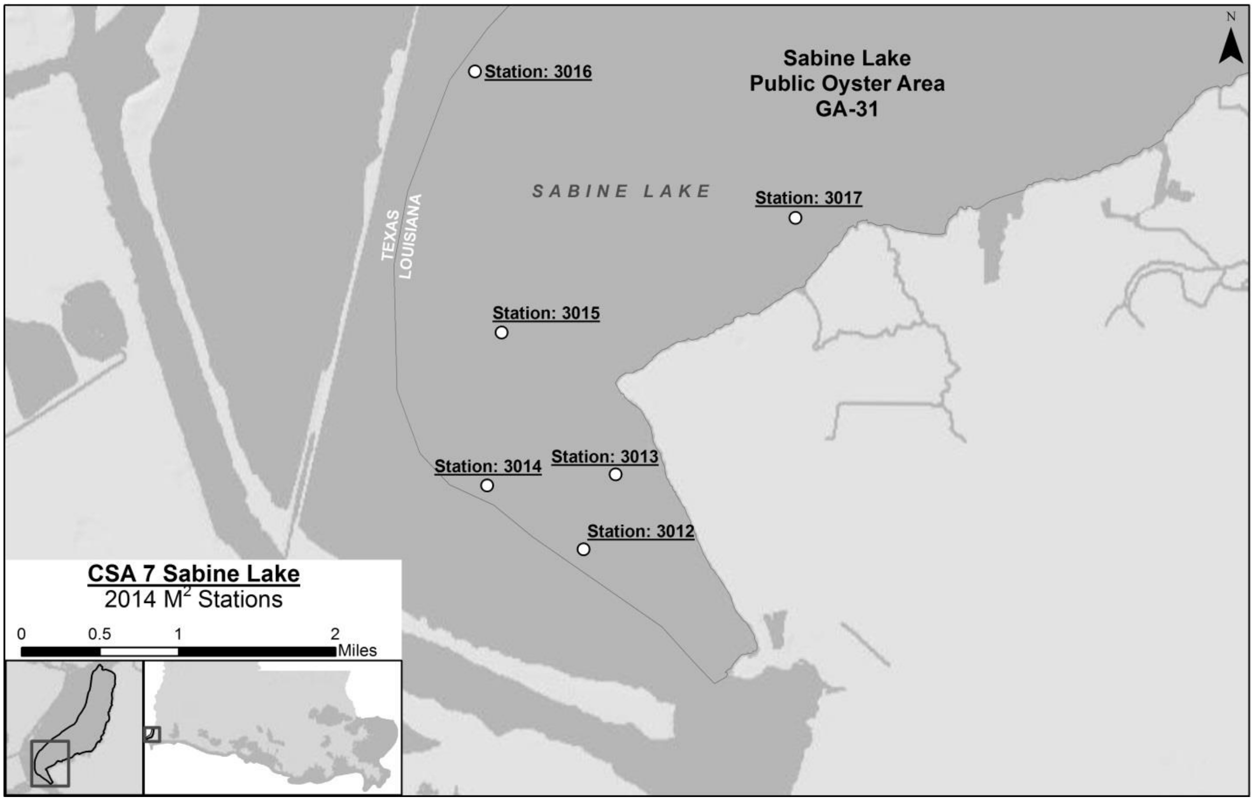

Figure 7.2. LDHH public oyster harvest area (GA-31) and LDWF meter square sampling station locations, Sabine Lake, Cameron Parish, Louisiana.

Prior to 2011, oyster reef acreage in Calcasieu Lake was estimated to total approximately 1,690.95. West Cove was estimated to contain 726.98 acres of reef and the Eastside approximately 963.97 acres. Since 2011, the LDWF oyster stock assessments in Calcasieu and Sabine Lakes have utilized acreage estimates determined by side-scan sonar water bottom assessments performed in 2008 and 2011. All suitable oyster habitat (Bottom Type IIIB) within the LDHH harvest areas of Calcasieu and Sabine Lakes was identified and categorized into two classification types: Reef and Exposed Shell. Based on the results of the side-scan surveys it is estimated GA-29 has a total of 1,962.3 acres of suitable oyster habitat which includes 1,435.8 acres of Reef and 526.5 acres of Exposed Shell bottom type and GA-30 has a total of 3,387.8 acres of oyster habitat which includes 1,119.6 acres of Reef and 2,268.2 acres of Exposed Shell bottom type (Figure 7.3). These estimated acreage figures generated from the side-scan surveys only include those areas of Calcasieu Lake that lie within the LDHH-allowed harvest area. Additional reefs are known to exist in Calcasieu Lake, but are outside the harvest areas and were not sampled for this assessment.

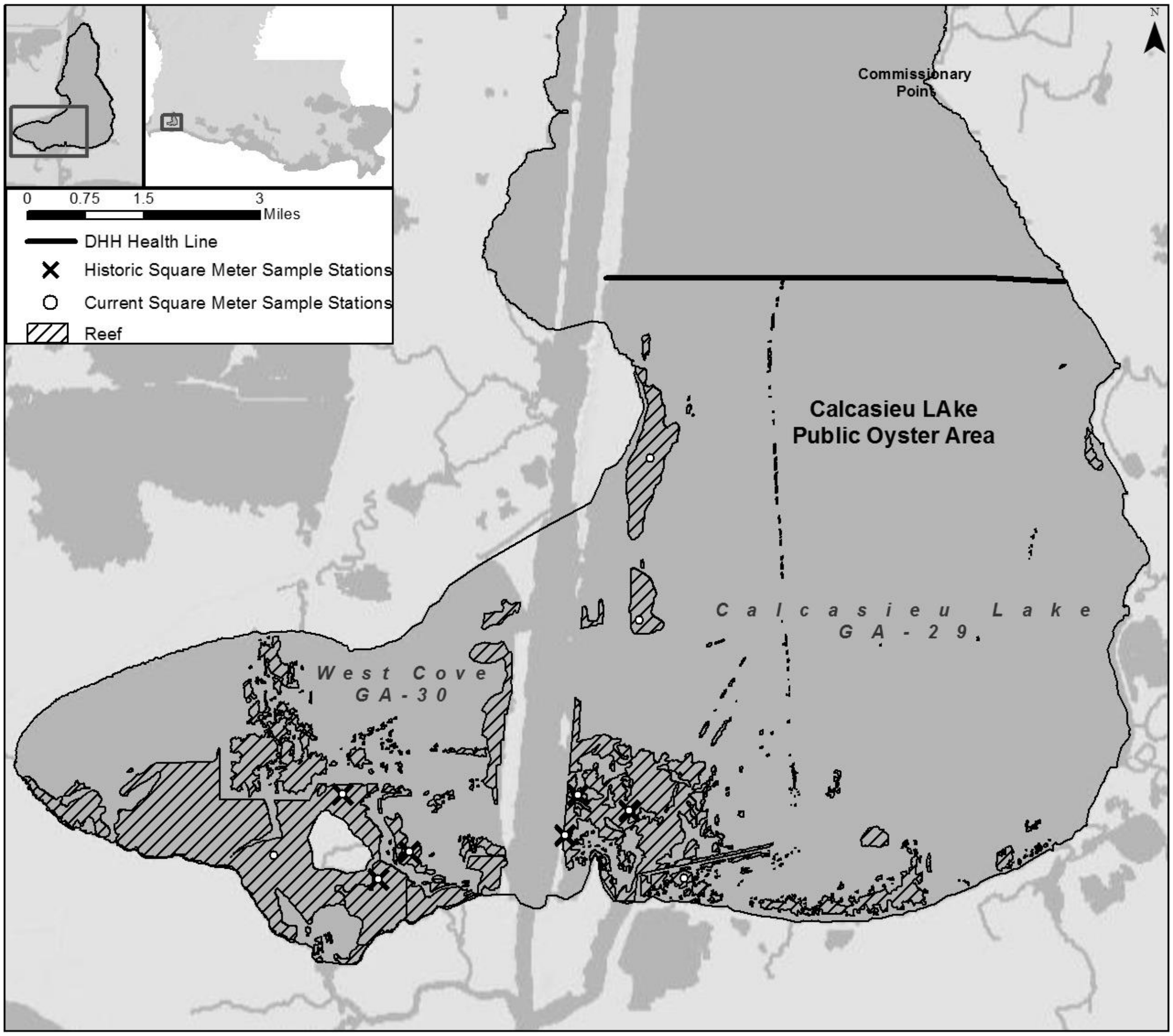

Figure 7.3. Estimated oyster habitat (Bottom type IIIB) coverage as delineated by side-scan sonar water bottom assessments Calcasieu Lake, Cameron Parish, Louisiana. “Reef” describes both consolidated and exposed, scattered shell water bottoms.

It is estimated GA-31 has a total of 1,479.5 acres oyster habitat which includes 1,041.0 acres of Reef and 438.5 acres of Exposed Shell bottom type (Figure 7.4).

LDWF placed a 14.3 acre cultch plant in the southern portion of GA-29 (on the south side of the “Old Revetment”) in May of 2009. This area has failed to develop into a sustainable area suitable for harvest.

In June of 2015, LDWF had contractors deposit approximately 12,500 cubic yards of cultch material over 63 acres of water bottom in Calcasieu Lake to create artificial reefs. The material was deposited in three locations (Figure 7.5). The largest reef, approximately 25 acres, was constructed in West Cove.

An additional 20 acres was constructed near Lambert's Bayou on the east side and the smallest reef was constructed near Commissary Point. The Commissary Point reef is located just north of the approved oyster harvest area. The goal of the project was to enhance oyster productivity in areas of Calcasieu Lake where reef bottom types were already present.

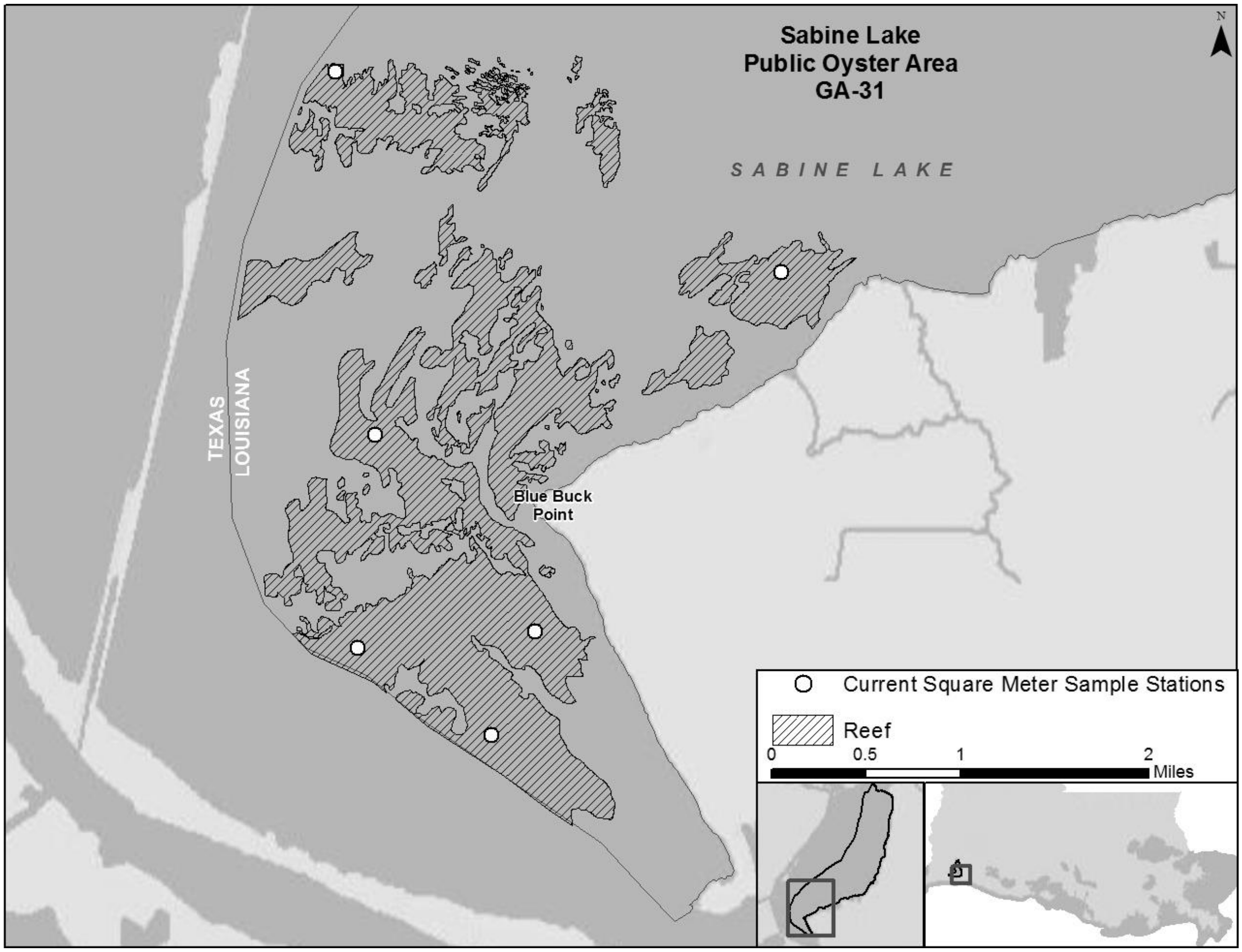

Figure 7.4. Estimated oyster habitat (Bottom type IIIB) coverage as delineated by side-scan sonar water bottom assessments Sabine Lake, Cameron Parish, Louisiana.

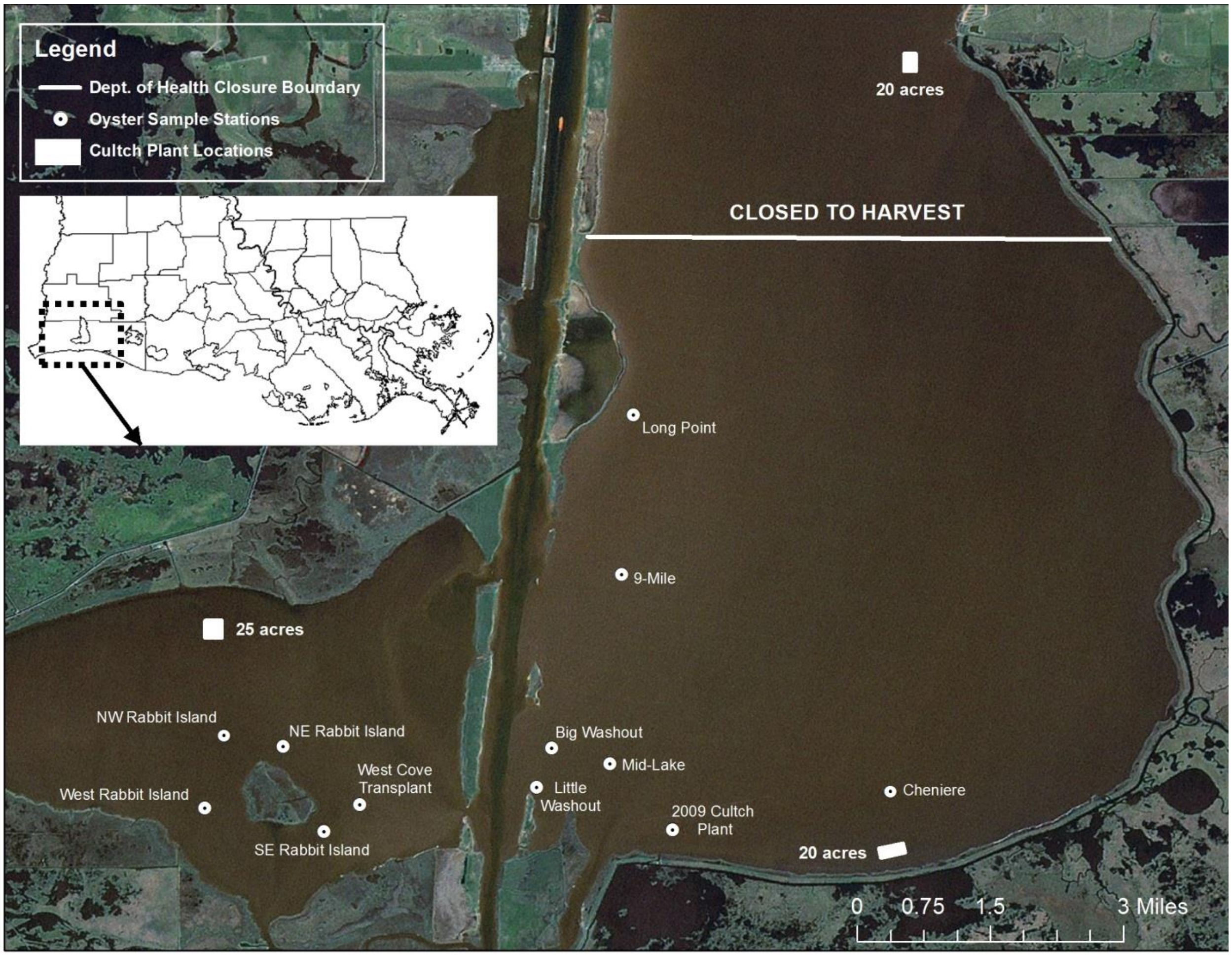

Figure 7.5. Locations of cultch plant reefs constructed in 2015, Calcasieu Lake, Cameron Parish, Louisiana.

Methods

Traditional Sampling Assessment

The oyster assessment for Calcasieu and Sabine Lakes is derived by collecting quadrat (one square-meter) samples at designated sampling locations. Historically, there were three designated stations in GA-29 and three in GA-30, until 2011 when three additional stations were added in GA 29 and one additional station was added in GA 30.

In an attempt to more accurately describe oysters resources throughout the Calcasieu Lake harvest area, two additional sample stations were added for stock assessment purposes in 2015, one in each growing area (Figures 7.1).

The additional sample station chosen in GA30 consisted of exposed reef bottom type and is located in an area that is frequently targeted by commercial oyster harvesters.

For the past several years oyster productivity at the historic sampling sites in GA29 has been bleak and it was assumed that these sampling sites were an accurate representation of the oyster resources throughout the area. In an attempt to validate this assumption LDWF staff began exploring select areas in GA29 to examine additional oyster resources. During these investigations, additional areas within GA29 were found to contain relatively healthy oyster populations. The areas found were located farther east than the historic sampling sites and so a decision was made to add an additional sampling site in this area. The additional sampling station chosen for GA29 is located on an artificial oyster reef created in 2007. In regards to population estimates, the oyster densities calculated at this sample site were extrapolated to an area estimated to encompass approximately 250 acres of reef bottom type.

A total of six stations are located in GA-31 (Figure 7.2), and these stations have been sampled each year since oyster assessments were begun in Sabine Lake in 2010.

The samples are collected when a square-meter quadrat is randomly deployed in an area very near to the designated sample station location. A SCUBA diver collects all live and dead oysters and shell on the top portion of the reef substrate within the quadrat frame and places them in number baskets. Five replicate samples are taken at each station.

All live and recent dead oysters are measured and recorded in five millimeter (mm) groups. Size classes are grouped into three categories – spat (<25mm), seed oysters (25mm – 74mm) and market oysters (75mm and larger). Oyster predators, and Hooked mussels (*Ishchadium recurvum*) that are collected are identified and total numbers recorded. As no bedding (seeding) operations occur in Calcasieu and Sabine Lakes, and all harvest is for direct market, the results of data collected are reported in sacks of seed and market sized oysters (seed – 360 oyster equals one sack, market – 180 oysters equals one sack) rather than in barrels, the standard oyster unit of measure utilized in other parts of coastal Louisiana (two sacks = one barrel).

Random Square Meter Assessment

An alternative sampling method for stock assessment was tested in West Cove by using random sample stations, as opposed to the traditional method of visiting established, historical stations. A quarter mile grid system was used to divide the existing oyster habitat in West Cove into blocks. From these available oyster habitat blocks, 25 randomly selected locations were chosen, and a single square meter sample was collected at each location. Collection and processing of the samples is identical to the method described previously for the traditional samples.

Cultch Plant Assessment Method

The oyster assessment of newly constructed cultch plantings was accomplished by collecting ¼ square meter samples at randomly selected points within the area. A total of 5 sites were chosen at random for each cultch plant area and a single sample was collected at each site.

Results/Discussion

Calcasieu Lake

Based on the data collected during the 2015 stock assessment of public oyster harvest areas in Calcasieu Lake it is estimated that the current stock is approximately 71,371 sacks of market-sized oysters and 83,838 sacks of seed oysters (Table 7.1). The majority of Calcasieu Lake's market-sized oysters were located in West Cove (GA30) while the seed-sized oysters were found to be more abundant on the East Side (GA29).

Table 7.1. Assessment of oyster resources estimated using standardized meter square sampling of public oyster harvest areas located in Calcasieu Lake, Cameron Parish, Louisiana, 2015.

Public Oyster Area	Bottom Type IIIB	Seed Oysters per m2	Market Oysters per m2	Reef Acreage	Square Meters	Sacks of Seed Oysters	Sacks of Market Oysters
GA29	Nonproductive Reef	0.55	0	1,179.8	4,774,485.4	7,294.4	-
	Productive Reef	14.4	3	250.0	1,011,715.0	40,468.6	16,861.9
	Exposed Shell	0	0	526.5	2,130,671.8	-	-
	2015 Culch Plant	0	0	20.0	80,937.2	-	-
					Total GA29	**47,763.0**	**16,861.9**
GA30	Reef	1.2	0.47	1,097.2	4,440,214.8	14,800.7	11,511.7
	Exposed Shell	0.8	0.8	2,265.6	9,168,566.0	20,374.6	40,749.2
	2015 Culch Plant	3.2	4	25.0	101,171.5	899.3	2,248.3
					Total GA30	**36,074.6**	**54,509.1**
					Total Harvest Area	**83,837.6**	**71,371.0**
						Seed/Market Total (Sacks)	**155,208.6**

The addition of the Chenier Reef sampling site in 2015 has resulted in the appearance that oyster populations in GA29 are recovering. Oyster populations at the historic sampling sites continue to exhibit no clear signs of recovery and oyster densities in these areas continue to be at or near zero. There are no market-sized oysters present and very little seed and spat despite the area being closed to harvest for the last four years and extensive deployments of hatchery-raised oyster larvae over these reefs. There is evidence based on dredge sample data that spat will set on shell material in these locations, but very few survive to seed-size and none have been documented to grow to market-size over the last four years. It is unclear at this time what environmental conditions are preventing oyster spat from developing into seed and market oysters.

There is speculation that sustained elevated salinity levels may be having an impact on recovery of oyster resources in GA29. There is clear evidence based on water quality measurements collected during sampling events since 1968 that annual salinity levels in the lower Calcasieu Lake sub-basin have gradually increased over time (Figure 7.6). High salinity levels can negatively affect oysters in several ways. It can cause mortality by providing optimal conditions for oyster predators. It can also be cause oysters to become more susceptible to the oyster disease known as “Dermo.” If salinity levels continue to increase, optimum oyster production will become more limited.

Other factors that might be contributing to slow oyster recovery in GA29 are sedimentation, hypoxia, and ocean acidification. Very little data currently exists to investigate the impacts of these conditions on oysters in this area, but research has shown that they can be limiting factors for oysters in some areas.

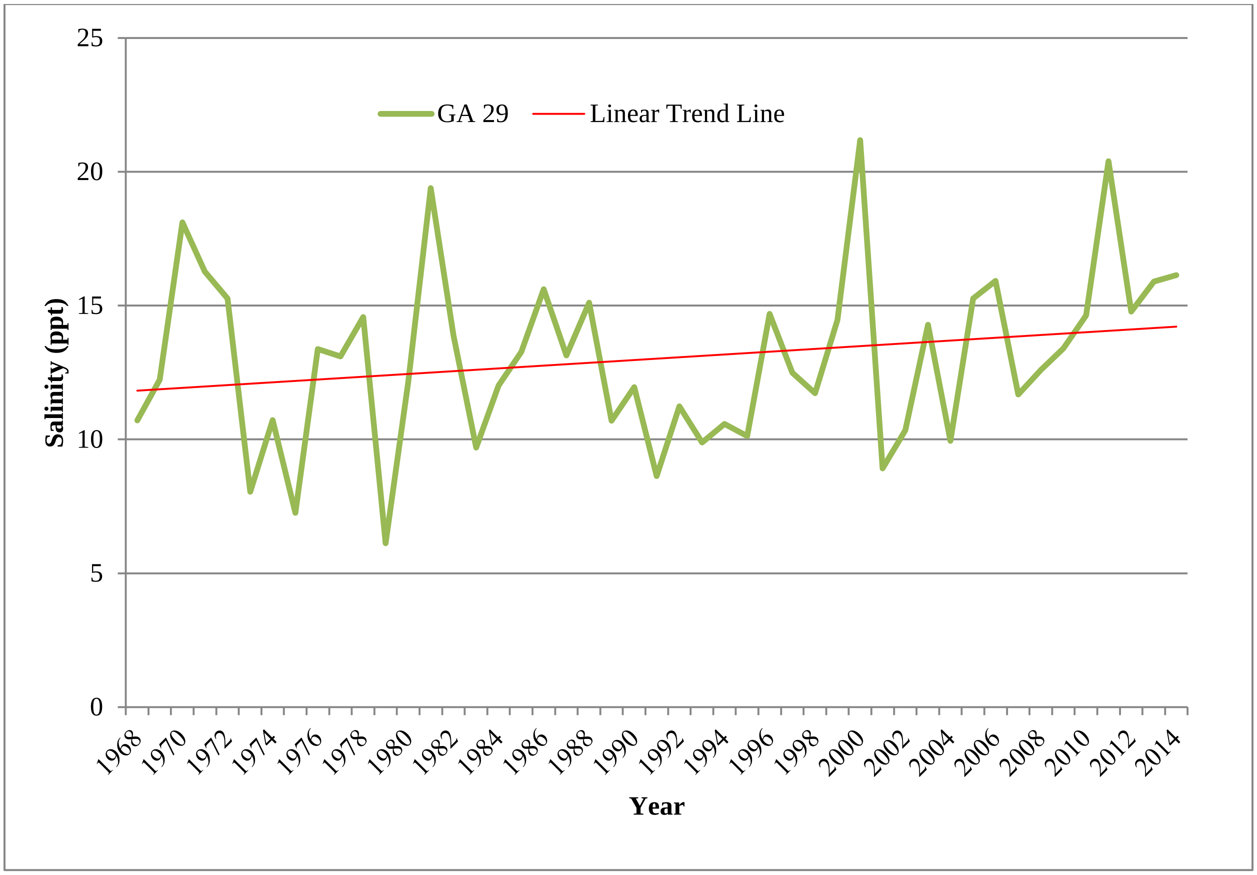

Figure 7.6: Average annual salinity recorded at sampling stations located public oyster harvest area GA29, Calcasieu Lake, Cameron Parish, Louisiana.

The health of oyster populations in GA30 has been a concern recently since oyster populations in GA29 declined to a point that forced a closure of harvest in that area since March 2011. The effect of the closure has been to condense and intensify harvest pressure in GA30.

Total stock of market-sized oysters in GA30 experienced a 71.1% reduction from the 2014 assessment (Table 7.2), and overall densities (numbers/m^2) continue to decline (Figure 7.7). The cause of the reduction in market oysters in GA30 is not entirely known but may be related to poor recruitment of seed oysters into the population.

Because the amount of seed oysters in a population represents future recruitment to market-sized oysters, it is critically important to maintain healthy populations to replace the individuals lost due to mortality. Anything that causes a reduction in this recruitment bank can have significant impacts on future oyster stocks.

The 2014 assessment of seed oysters in GA30 resulted in an increase in population of 259% over the 2013 assessment. It was hoped that the significant increase in numbers of seed oysters would result in a sizable increase in market oysters for the 2015 assessment, but that increase did not occur

Table 7.2. Oyster stock assessments and percentage change of public oyster harvest areas in Calcasieu Lake, Cameron Parish, Louisiana.

	MARKET OYSTERS (≥ 3”)		SEED OYSTERS (< 3”)	
YEAR	GA29	GA30	GA29	GA30
2008	752,061.90	142,199.90	449,720.00	212,483.30
2009[1]	612,687.30	711,613.60	191,435.50	422,520.60
2010[1]	23,540.10	689,375.70	8,545.30	605,983.50
2011[2]	27,007.80	594,744.10	52,831.90	308,927.20
2012	0	236,439.50	0	85,171.20
2013	0	169,038.40	0	59,510.90
2014	0	188,616.05	24,210.34	213,950.52
AVERAGE	**202,185.30**	**390,289.61**	**103,820.43**	**272,649.60**
2015	16861.9	54,509.11	47,762.95	36,074.61
% CHANGE FROM AVE.	-91.7	-86.0	-54.0	-86.8
% CHANGE FROM 2014		-71.1	97.3	-83.1

1 – assessed using updated reef acreage from ENCOS (3,907.1) in 2008.

2 – assessed using updated reef acreage from ENCOS (2008) and Bio-West (2011).

It is possible that the reduction in market-sized oysters in GA30 for 2015 is a result of low recruitment of seed oysters due to higher than normal mortality. Following the 2014 stock assessment, seed oysters in GA30 experienced relatively high mortality rates from August, 2014 through June, 2015 (Figure 7.8). The assumption can be made that the loss due to natural mortality resulted in fewer oysters moving from the seed size class into the market size class. Combine this with the known fishing mortality associated with harvest and one can easily see how this might result in a significant reduction of market sized oysters in the 2015 stock assessment. At this time there is no data that clearly indicates the cause of the mortality of seed oysters in GA30.

Identifying recent mortality in oyster samples can be a difficult process, however. Recent mortality is defined in the LDWF oyster sampling program as any oyster that died since the last sampling effort. For our purposes this time frame is approximately 30 days. Much is not known about the accuracy of identifying recent mortality. It can be extremely difficult to distinguish recent death from older death. The degree of fouling of the oyster shell is used many times to gauge the duration of time since death. Some limited research recently has revealed that the rate and degree of fouling may be influenced by many different factors, including salinity levels, temperature, and others. If conditions are such that fouling occurs very quickly an individual may be reluctant to identify a shell as recent mortality even if the death occurred within sampling period. On the other hand, if fouling is slow, an individual may identify shell as recent mortality even though the death occurred months earlier. Another inherent problem is the inconsistency between individuals processing samples. One may classify an oyster as a recent mortality when another may not.

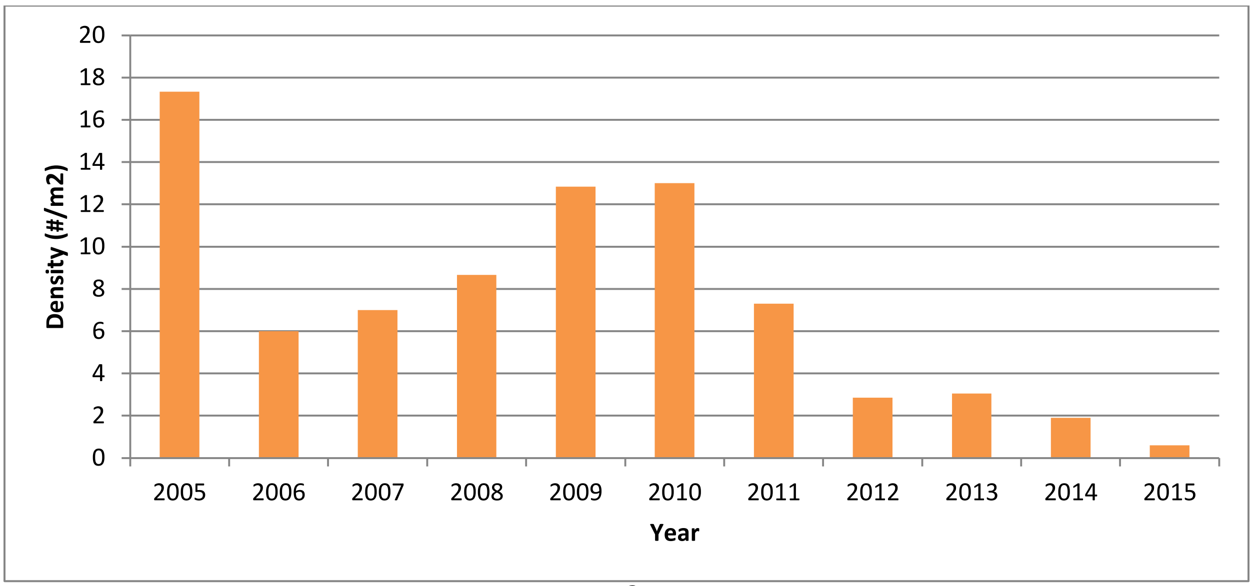

Figure 7.7. Population densities (live oysters/m^2) of market-sized oysters collected at all sample locations during meter square samples from Growing Area 30 (West Cove), Calcasieu Lake, Cameron Parish, Louisiana.

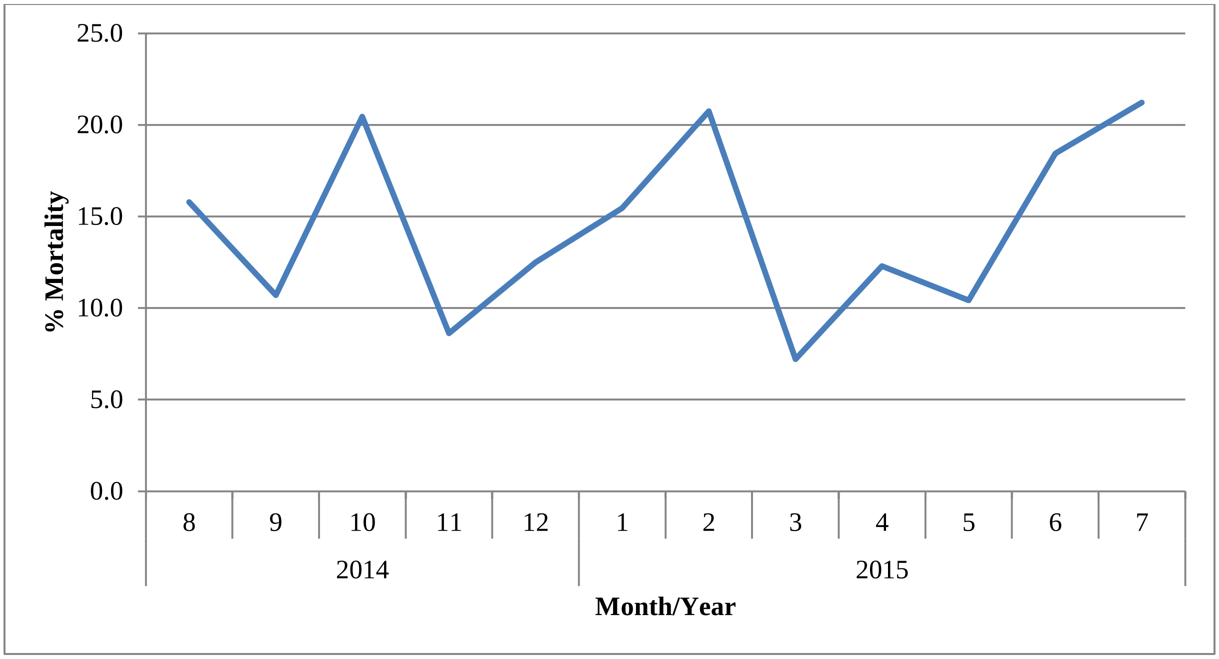

Figure 7.8: Percent mortality of seed-sized oysters collected during monthly dredge samples and square meter samples collected from public oyster harvest area GA30, August 2014 through July 2015, Calcasieu Lake, Cameron Parish, Louisiana.

Since no data exists on fouling rates of smaller size classes of oysters, one must use caution when examining mortality estimates due to the potential for inaccurate mortality determinations. Additional research is needed to better understand fouling rates of oyster shell so that a more accurate determination can be made in regards to recent mortality.

Recruitment

Of particular concern for the 2015 stock assessment is the reduction of seed-sized oysters in GA30. The estimates indicate a reduction of over 83% from last year's assessment in this area. This reduction of seed oysters will likely result in fewer market oysters available for harvest.

The density of oyster spat collected in GA-30 was estimated to be 1.32 individuals/m^2. This number is slightly lower than the estimate from last year's assessment of 1.4 individuals/m^2. The hope of successful recruitment of last year's spat set to translate into an increase in stock of seed -sized oysters did not materialize. The cause of this failure is not known, but may be attributed to several factors which have been discussed earlier in this report. A major concern is that oyster resources in GA30 may be impacted by the same conditions that are preventing oyster resources in GA29 from recovering.

The result of the new station (Chenier Reef) located in the highly productive reef areas of GA29 is a density of 1.8 individuals/m^2 which is only slightly higher than the 1.55 individuals/m^2 found at other sample locations. The density of spat at the existing, historic stations did not change from last year's assessment

No attempts to release hatchery reared oyster larva in GA29 were made this year prior to the stock assessment sampling. It appears the previous year's attempts were not very successful.

Whatever the reason for declines in oyster populations in GA30 it appears, based on the 2015 stock assessment, oyster resources have declined to such a point that the current populations may not be sustainable without strong management actions aimed at oyster rehabilitation in this area.

Hydrology

Average water temperatures recorded during dredge samples for Calcasieu Lake in May and June were 24.0°C and 28.3°C respectively. These temperatures are slightly below the (LTA) of 2000-2015 (Figure 7.9). The average water temperature during the oyster assessment was 27.9°C which is lower that the LTA of 29.6°C.

Average salinities (in parts per thousand - ppt) for May and June were 9.7 and 7.3ppt respectively which is significantly lower than the LTA for this time period (Figure 7.9). The average salinity during the oyster assessment was 16.8ppt which is below the LTA of 18.6ppt. High rainfall amounts in the upper Calcasieu River basin during the spring resulted in much lower salinity levels in the lower Calcasieu Lake sub-basin during the spring and early summer. At the time samples were collected for the stock assessment, salinity levels had increased to near normal levels for this time period.

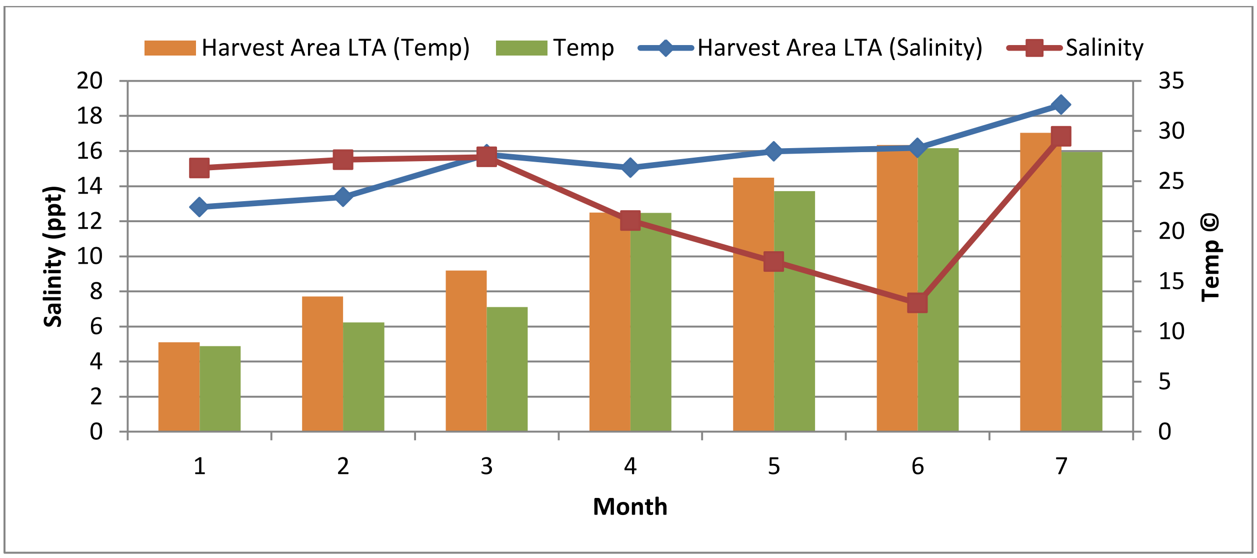

Figure 7.9. Salinity and temperature measurements recorded during dredge and square meter samples of the Calcasieu Lake public oyster harvest area, Calcasieu Lake, Cameron Parish, Louisiana, 2015.

Disease, Fouling Organisms, and Predators

The southern oyster drill has become a major concern on public oyster harvest areas in Calcasieu Lake in recent years. Prior to 2009, very few oyster drill snails were recorded in standardized monthly samples. Beginning in 2009 oyster drill numbers recorded in monthly dredge samples began to increase and following an extended drought period in mid-2010 through 2011 numbers increased significantly. Although a freshwater influx occurred during February – April 2012 the numbers of oyster drills did not appear to be altered significantly based on numbers recorded during dredge sample efforts for that year. Dredge sample data in 2013-2015, however, indicate that oyster drill populations appear to be declining in the harvest areas of Calcasieu Lake (Figure 7.10). It is not known at this time if the decline in oyster drill populations is a result of less-that-optimum environmental conditions caused by extensive spring rainfall or a lack of availability of prey.

Despite the low salinity conditions experienced in the spring and early summer 2015, the number of oyster drills collected during square meter sampling increased to eight total collected in all samples up from two in 2014. It is unclear at this time what impact these predatory snails are having on oyster populations in this area.

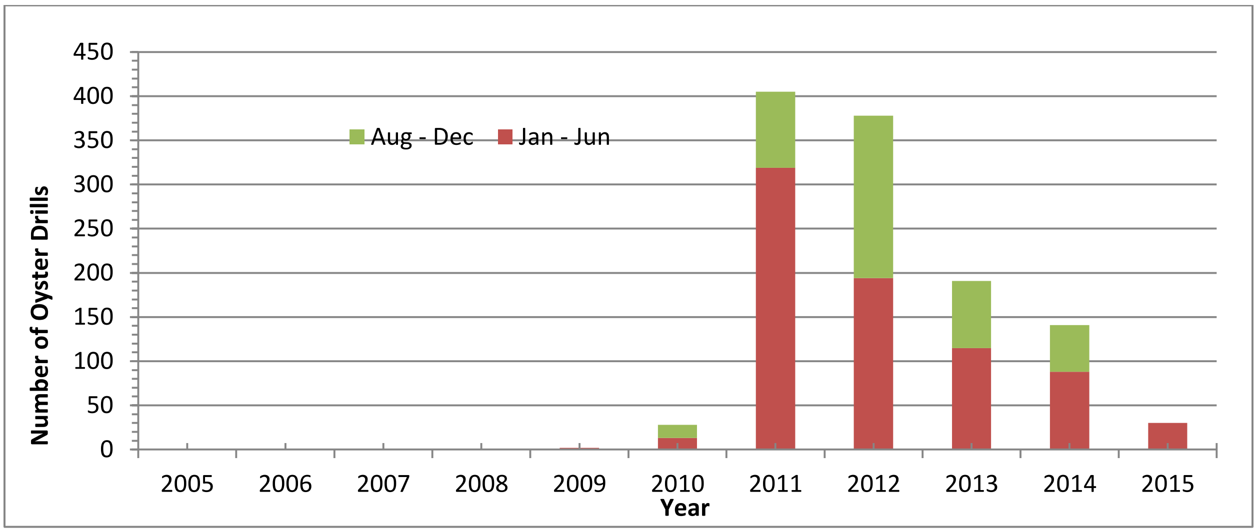

Figure 7.10. Total oyster drills (*Stramonita haemastoma*) collected in standardized dredge samples, Calcasieu Lake, Cameron Parish, Louisiana.

Two hooked mussels were found in the GA-29 assessment this year. In our assessment of GA30, we recorded an average density of 0.72 mussels/m^2, which is significantly less than last year's assessment density of 12.4/m^2.

A total of eleven unidentified mud crabs were collected during the assessment of the harvest area. No other species of concern were encountered.

Sabine Lake

Based on data collected during the 2015 oyster stock assessment, it is estimated that GA31 contains approximately 361,597 sacks of market-sized oysters and 155,455 sacks of seed oysters (Table 7.3). These numbers represent an overall decline in both seed and market-sized oysters of 64.3% and 39.8% respectively from last year's assessment and makes this the second year in row where a decline in abundance of market-sized oysters was observed (Table 7.4). This trend extends to seed-sized oyster as well with this marking a three year decline in abundance (Figure 7.11).

The reduction in stock of market oysters can be explained by the high mortality experienced during low salinity periods during April and May (Figure 7.12). Unusually high rainfall amounts in the upper Sabine River basin caused extended periods of low salinity in the lower lake sub-basin. Two stations, SL5 and SL6, located in the most northerly region of the assessment area fared the worst in regards to percent mortality. These two stations experienced salinity conditions of less than one ppt for four months (Figure 7.12). Unlike the sustained higher than normal mortality estimates in GA30, there is no question about the cause of mortality of oysters in GA31. There is some question about the duration of this mortality event. Due to slower fouling rates associated with fresh water conditions, it is possible that high mortality estimates were projected over a longer period of time.

Despite the large decrease in market-sized oysters in GA31, it is expected that oyster resources will rebound after salinity conditions in the lower lake return to acceptable levels. There is an acceptable population of seed-sized oysters remaining which should develop into the market size. Major die offs of oyster populations as a result of low salinity conditions is fairly common in SE Louisiana due to river diversions and major flooding events of the Mississippi and Atchafalaya Rivers. Oyster populations in Sabine Lake should recover fairly quickly from this event and no long term affects are expected, however, LDWF will closely monitor oyster resources to ensure populations return to healthy levels.

Table 7.3. Assessment of oyster resources estimated using standardized meter square sampling of public oyster harvest area GA-31 in Sabine Lake, Cameron Parish, Louisiana, 2015.

Public Oyster Area	**Bottom Type IIIB**	**Seed Oysters per m2**	**Market Oysters per m2**	**Reef Acreage**	**Square Meters**	**Sacks of Seed Oysters**	**Sacks of Market Oysters**
GA31	Reef	13.2	15.5	1,041.0	4,212,781.3	154,468.6	361,597.1
	Exposed Shell	0.2	0	438.5	1,774,548.1	985.9	-
					Total	**155,455**	**361,597**

Table 7.4. Oyster stock assessments and percentage change of public oyster harvest area GA-31 in Sabine Lake, Cameron Parish, Louisiana.

YEAR	MARKET OYSTERS (≥ 3”)	SEED OYSTERS (< 3”)
	GA31	GA31
2010	478,985.90	436,409.40
2011	1,031,976.20	406,141.10
2012	890,693.90	552,007.60
2013	1,110,940.90	391,261.20
2014	1,014,047.57	258,108.73
AVERAGE	**905,328.89**	**408,785.61**
2015	361,597.06	155,454.51
% CHANGE FROM AVE.	-60.1	-62.0
% CHANGE FROM 2014	-64.3	-39.8

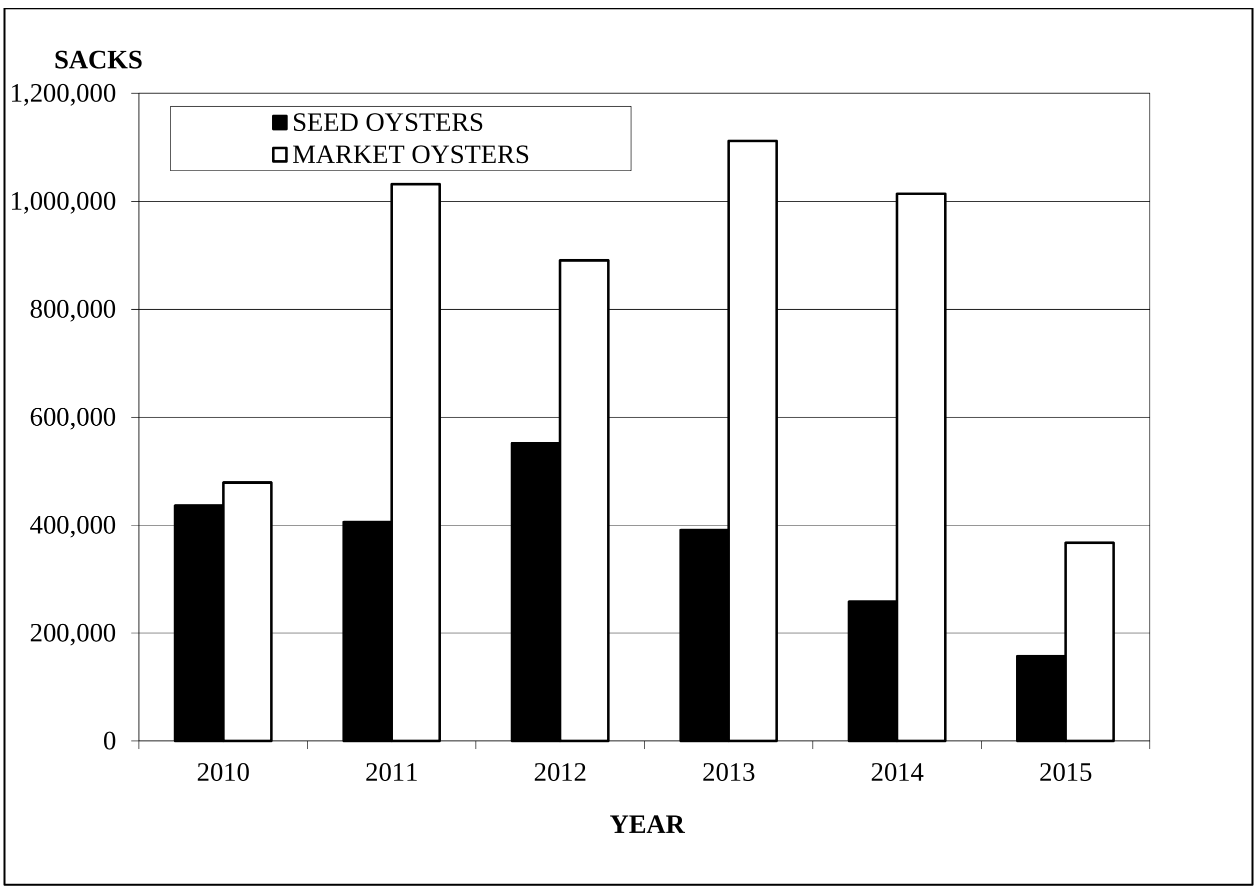

Figure 7.11. Trend of annual oyster stock assessments of public oyster harvest area GA-31 in Sabine Lake, Cameron Parish, Louisiana, 2010 to 2015.

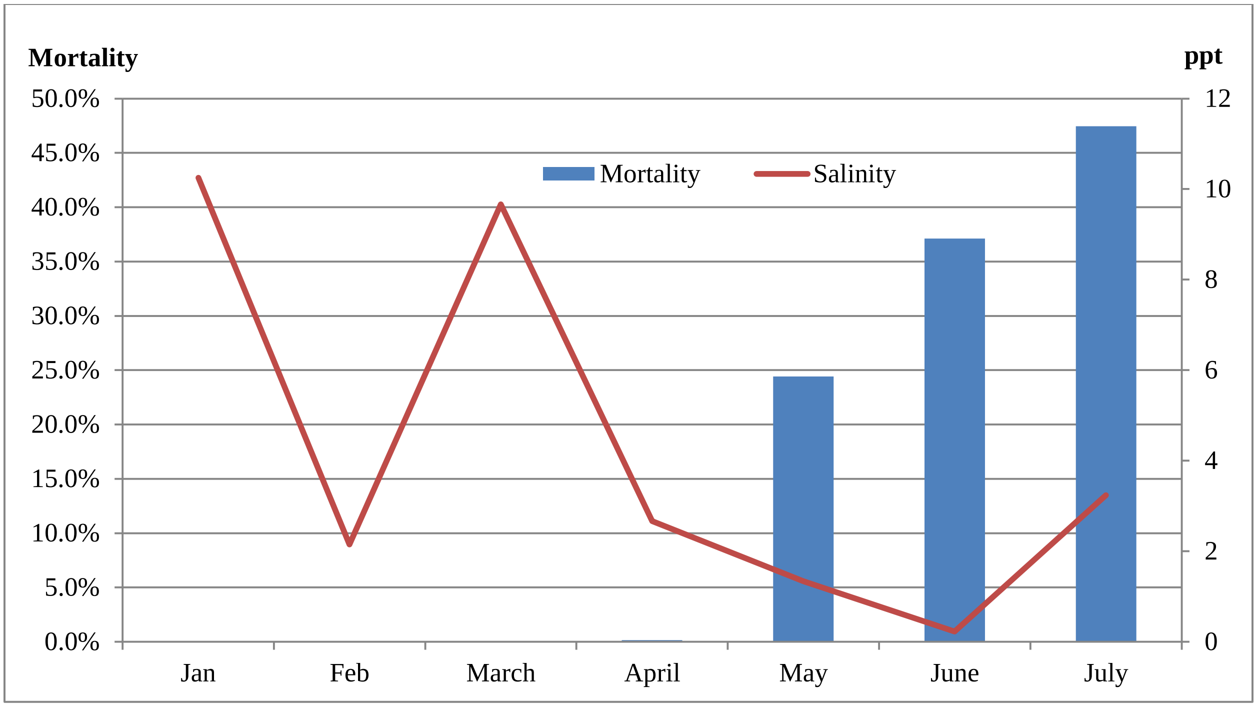

Figure 7.12. Average percent mortality of market-sized oysters and average salinity recordings collected during dredge and square meter samples of public oyster harvest area GA31 in Sabine Lake, Cameron Parish, Louisiana, 2015.

Hydrology

Average water temperatures recorded during dredge samples for Sabine Lake in May and June were 24.0^{o}C and 26.9^{o}C respectively. These temperatures are below the average over the last five years (Figure 7.12). The average water temperature during the oyster assessment was 29.4^{o}C which is slightly lower that the average over the last five years of 29.9^{o}C.

Average salinities (in parts per thousand - ppt) for May and June were 1.3 and 0.2ppt respectively which is significantly lower than the last five year average for this time period (Figure 7.13). The average salinity during the oyster assessment was 3.2ppt which is also significantly lower than the last five year average of 12.8 ppt. Extremely high rainfall amounts in the upper Sabine River basin during the spring and early summer resulted in much lower salinity levels in the lower Sabine Lake sub-basin during the spring and early summer. Salinity levels at the sampling locations in the southern part of the lake were just beginning to come up at the time of the stock assessment. Salinity levels recorded at the northern most stations were still below 1ppt at the time of the assessment. The duration of low salinity levels had a tremendous impact on survival of oyster resources in these regions.

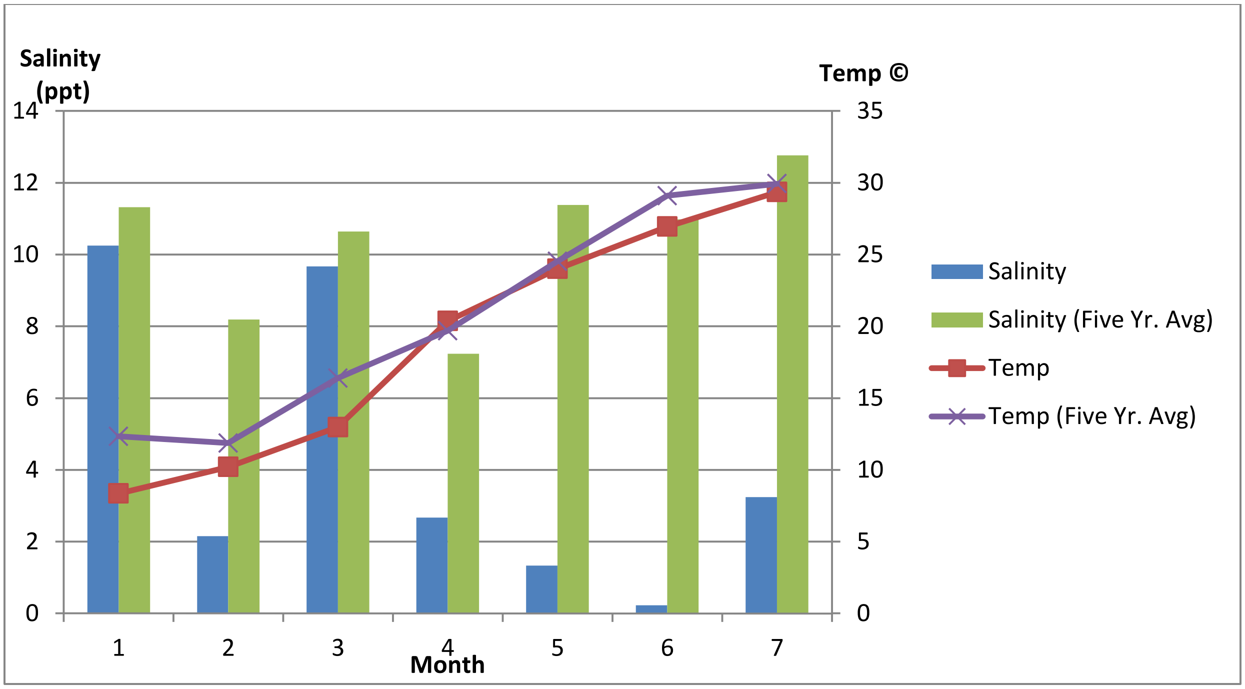

Figure 7.13. Salinity and temperature measurements recorded during dredge and square meter samples of the public oyster harvest area GA31, Sabine Lake, Cameron Parish, Louisiana, 2015.

Disease, Fouling Organisms, and Predators

The 2015 assessment of GA-31 found hook mussel densities to average 16.7 mussels/m^2 which is significantly lower than the average density of 242.0/m^2 found in the 2014 assessment. It is presumed that the large reduction is attributed mortality associated with the extremely low salinity levels prior to the assessment.

A total of 21 unidentifiable mud crabs were collected during the assessment. No other species of concern were encountered.

Cultch Plants

The July assessment sampling of the newly constructed cultch plants in GA29 and GA30 revealed few spat had developed on the new material, with a total of four spat recorded. This was not very surprising considering the limited time frame between completion of the project and the assessment, and the low salinities experienced during the time cultch was being deployed. However successful spat settlement was observed on all three cultch plants during fall dredge sampling.

Future assessments

An attempt was made this year to test an alternative method for conducting the oyster stock assessment in Calcasieu Lake. A random site selection approach was used to evaluate oyster populations in GA30. The area was divided into ¼ square mile grids. Any grid that contained appropriate oyster bottom habitat had an opportunity to be selected for sampling. The grids were identified as predominantly reef habitat or predominantly exposed shell based on bathymetry data. The current standardized assessment utilizes 5 sampling locations in West Cove with three being located in areas of exposed reef bottom type and two located in areas of exposed shell bottom type. Five replicate samples are collected at each of the 5 sampling sites for a total of 25 samples.

In an effort to compare the two assessment methods it was decided to collect the same number of samples as the standard protocol and maintain the same proportion in regards to bottom type. A total of 15 random locations were selected from the exposed reef grids and 10 were selected from the exposed shell grids. The center point of each grid was used as the specific sampling location unless that location did not contain suitable oyster bottom in which case the specific location was moved to a location within the grid that did possess the preferred bottom type. Five alternate grids for each were selected for each bottom type in the event a location was deemed inaccessible due to shallow water conditions. A single square meter sample was collected in each of the selected grids.

The results of the oyster stock assessment using the random grid method are presented in Table 7.5. The estimated oyster stock in GA30 using this method is 35,939 sacks of market-sized oysters and 62,605 sacks of seed. This is a reduction of 34.1% for market-sized oysters compared to the standardized stock assessment. Estimates for seed-sized oysters increased 73.5% using the random grid method.

Table 7.5. Comparison of oyster stocks estimated using standardized assessment methods and random grid methods from public oyster harvest area GA30, Calcasieu Lake, Cameron Parish, Louisiana, 2015.

	Sacks Spat	Sacks Seed	Sacks Market
Standard Assessment	22,262.5	36,074.6	54,509.1
Random Grid Assessment	24,558.3	62,605.2	35,939.1
% Change from Standard	10.3	73.5	-34.1

<u>2014-15 Oyster Season</u>

Agreeing with recommendations from LDWF and the Louisiana Oyster Task Force, the Louisiana Wildlife and Fisheries Commission continued to keep GA-29 closed to oyster harvest and opened GA-30 on October 26, 2014 and closed on April 30, 2015 (Table 7.6). The sack limit was set at 10 sacks per day for the entire season. GA31 remained closed.

Calcasieu Lake oyster landings data via the LDWF Trip-Ticket program indicate there were 46,336 sacks reported as landed during the 2014-15 season (Table 7.7, Figure 7.13), which represents a 15.4% increase over last season's report of 40,163 sacks landed. Prices for harvested oysters continue to remain high and harvest effort remains strong. Based on harvest data it is estimated that approximately 45 boats/day were actively harvesting oysters is GA30 during the 2014-2015 season. This represents a 55.5% increase in daily effort over last year's daily effort of 27 boats/day. Using the trip-ticket harvest numbers and comparing them with the 2014 stock assessment we estimate approximately 24.6% of the standing crop of market-sized oysters in GA-30 was harvested last season.

Closures to oyster harvesting in GA-30 due to LDHH health concerns were higher this season compared to last season. Of the 187 total days in the oyster season only 111 were open and available to harvest (Table 7.8). Heavy rainfall amounts in March and April resulted in extended periods of closure. Despite having significantly fewer days available to harvest, fisherman harvested more oysters this season that last season (Table 7.7, Table 7.8)

Table 7.6. Public oyster harvest season dates for GA-29 and GA-30, Calcasieu Lake, Cameron Parish, Louisiana

Season		REGULAR SEASON							TOTAL DAYS IN SEASON
		DATES			DHH HEALTH CLOSURES				
					EAST SIDE CALCASIEU LAKE		WEST COVE CALCASIEU LAKE		
		OPEN DATE	CLOSED DATE	TOTAL DAYS	DAYS OPEN	DAYS CLOSED	DAYS OPEN	DAYS CLOSED	
2004-05		10-15	4-30	198	168	30	68	130	198
2005-06	GA29	10-15	4-30	198	187	11			198
	GA30	10-8	4-30	205			165	40	205
2006-07	GA29	11-1	4-30	181	118	63			181
	GA30	10-16	4-30	197			70	127	197
2007-08	GA29	11-1	4-30	182					182
	GA30	10-15	4-30	199					199
2008-09	GA29	10-15	4-30	198	183	15			198
	GA30						125	73	
2009-10	GA29	10-15	4-30	198	157	41			198
	GA30						80	118	
2010-11	GA29	11-15	3-25[2]	131	131	0			131
	GA30[1]	10-15	4-30	196			186	10	196
2011-12[3]	GA29[4]	CLOSED	-	0	0	0			0
	GA30	11-1	4-30	181			92	90	181
2012-13	GA29	CLOSED	-	0	0	0			0
	GA30	11-1	4-30	181			82	99	181
2013-14	GA29	CLOSED	-	0	0	0			0
	GA30	11-1	4-30	181			158	23	181
2014-15	GA29	CLOSED	-	0	0	0			0
	GA30	10-26	4-30	187			111	76	187

1 – FROM 10-15 THROUGH 11-14, THE SACK LIMIT WAS 20; SACK LIMIT REVERTED TO 10 FOR THE REMAINDER OF THE SEASON IN BOTH GROWING AREAS.
2 – GA29 CLOSED DUE TO HEAVEY HARVEST PRESURE OF THE RESOURCE; SEE LDWF NEWSRELEASE 3/22/11.
3 – OYSTERING FROM CALCASIEU LAKE FOR THE 2011-12 SEASON WAS BY SPECIAL PERMIT ONLY, SEE NEWS RELEASE FROM 7/7/11 AND 9/15/11.
4 - GA 29 WAS CLOSED. SEE NEWS RELEASE FROM 9/1/2011.

Table 7.7. Historical stock assessments and landings (in sacks) of oysters from Calcasieu Lake

SEASONS	STOCK ASSESSMENT		ESTIMATED SACKS HARVESTED
	MARKETABLE	TOTAL	
1963	-	-	210,160
1967-74	-	-	NO COMMERCIAL LANDINGS
1975-76	142,726	441,183	40,000
1976-77	694,420	869,475	100,000
1977-78	483,673	621,885	141,976
1978-79	-	-	75,000
1979-80	676-333	979,613	125,000
1980-81	355,664	705,117	150,000
1981-82	608,110	988,575	-
1982-83	-	-	50,000-75,000
1983-84	-	-	150,000
1984-85	125,407	644,788	-
1985-86	315,160	537,760	27,400
1986-87	589,940	1,217,959	200,000
1987-88	796,950	2,703,647	125,000
1988-89	463,331	1,036,580	50,000
1989-90	172,046	640,892	40,000
1990-91	408,961	1,268,962	50,000
1991-92	1,048,882	1,731,367	31,383[1]
1992-93	749,915	1,612,736	27,328
1993-94	748,281	1,238,783	12,818
1994-95	756,525	1,246,480	6,134
1995-56	956,926	1,298,379	29,082
1996-97	618,767	1,083,866	43,441
1997-98	950,979	1,706,510	80,735
1998-99	702,371	1,160,115	39,202[2]
1999-00	614,145	1,032,117	58,960
2000-01	846,176	1,197,311	35,881
2001-02	1,163,750	2,409,482	21,297
2002-03	781,676	1,100,257	21,386
2003-04	1,169,997	1,700,663	18,196
2004-05	1,099,236	2,468,560	44,293
2005-06[3]	915,625	1,541,893	19,327
2006-07[4]	238,945	463,623	28,341
2007-08	662,747	1,638,496	49,529
2008-09	894,262	1,556,465	63,948[5]
2009-10[6]	621,006	873,099	137,074
2009-10[7]	1,398,437	1,972,920	
2010-11[8]	712,916	1,327,445	82,896
2011-12	594,744	903,671	29,666
2012-13	236,439	321,611	33,326
2013-14	169,038	228,549	40,163
2014-15	188,616	426,777	46,336
2015-16	67,999	151,836	

1 – STARTED USING DEALER REPORTS FOR LANDINGS.
2 – THE 1999 PORTION OF THE LANDINGS WAS DERIVED FROM PRELIMINARY TRIP TICKET DATA.
3 – HURRICAN RITE MADE LANDFALL ON 9/23/05 DELAYING SEASON OPENING, LIMITING THE NUMBER OF FISHERMEN AND BUYERS.
4 – A SEWAGE LINE BREAK IN BAYOU D'INDE CLOSED THE SEASON FOR THE ENTIRE MONTH OF APRIL, LIMITING THE LANDINGS.
5 – NO DATA WAS AVAILABLE FOR OCT.2008.
6 – ASSESSMENT USING THE REGULAR REEF ACREAGE.
7 – ASSESSMENT USING THE UPDATED REEF ACREAGE FROM ENCOS (2008).
8 – USING THE UPDATED REEF ACREAGE (2008) AND USING FIVE REPLICATES INSTEAD OF TWO.

Table 7.8. Public oyster harvest season lengths and number of days open to harvest as a percentage for GA-29 and GA-30, Calcasieu Lake, Cameron Parish, Louisiana.

SEASON		TOTAL DAYS	EAST SIDE CALCASIEU LAKE		WEST COVE CALCASIEU LAKE	
			OPEN DAYS	PERCENT	OPEN DAYS	PERCENT
1991-92		199	114	57	114	57
1992-93*		165	137	83	76	46
1993-94		181	146	81	84	46
1994-95		181	90	50	9	5
1995-96		188	175	93	115	61
1996-97		197	149	76	114	58
1997-98		197	139	71	96	49
1998-99		197	135	69	120	61
1999-00		197	197	100	182	92
2000-01		198	180	95	106	53
2001-02		198	158	80	61	31
2002-03		198	146	74	66	33
2003-04		199	172	87	126	63
2004-05		198	168	85	68	34
2005-06	GA29	198	187	94		
	GA30	205			165	40
2006-07	GA29	181	118	65		
	GA30	197			70	35
2007-08	GA29	182	165	91		
	GA30	199			131	66
2008-09	GA29	198	183	92		
	GA30				125	63
2009-10	GA29	198	157	79		
	GA30				80	40
2010-11	GA29	131	131	100		
	GA30	196			186	95
2011-12	GA29	Closed	0	-		
	GA30	181			92	51
2012-13	GA29	Closed	0	-		
	GA30	181			82	45
2013-14	GA29	Closed	0	-		
	GA30	181			158	87
2014-15	GA29	Closed	0	-		
	GA30	187			111	59

1 - 92-93 SEASON STARTED USING CALCASIEU RIVER GAUGE AT KINDER FOR DHH CLOSURES.
2 – STARTING WITH THE 2005-06 SEASON, THE LAKE WAS DIVIDED INTO TWO CONDITIONAL MANAGED AREAS (CMA),WERE MANAGED SEPERATELY AND MAY HAVE DIFFENENT LENGTH SEASONS.
3 – STARTING WITH THE 2010-11 SEASON THE CONDITIONAL MANAGED AREAS WERE CHANGED TO GROWNING AREAS (GA).

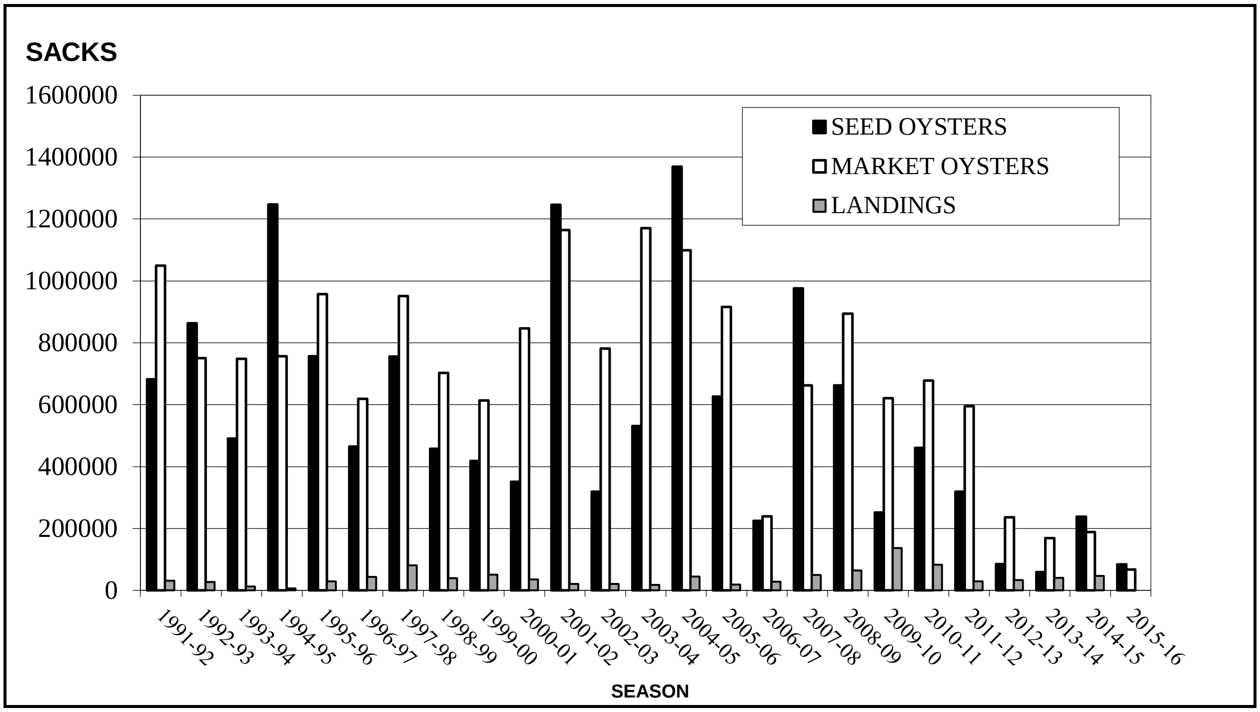

Figure 7.13. Historical stock assessments and landings (in sacks) of oysters from public oyster harvest areas of Calcasieu Lake, Cameron Parish, Louisiana.

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Levels of the parasite *Perkinsus marinus* in sack and seed oysters: Louisiana Public Seed Grounds, Summer 2015

by

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27 August 2015

Among the most significant causes of oyster mortality is the parasite *Perkinsus marinus* which is responsible for annual mortality rates that exceed 50% in many populations of adult eastern oysters, *Crassostrea virginica*. *Perkinsus marinus* was described in 1950 by John Mackin, Malcolm Owen and Albert Collier as *Dermocystidium marinum* – hence the common name "dermo" which is still in use (Mackin et al. 1950).

The discovery of the parasite was the result of investigations (funded by a consortium of oil companies and directed by Texas A&M University) of the impact of oil and gas activities on the Louisiana oyster industry (Mackin and Hopkins, 1962). Extensive studies were conducted on the effects of crude oil, bleed water, natural gas, drilling mud and seismographic surveys. It was ultimately realized that none of these pollutants or activities explained the widespread mortalities of oysters that were observed. It is now known that the parasite is a major cause of oyster mortality from Maine to Mexico (Soniat, 1996).

The critical environmental factors which favor the proliferation of the parasite are high water temperatures and high salinities. Thus infections are more intense in the late summer, on the seaward side of estuaries and during droughts. Drought conditions on the Gulf Coast are associated with the La Niña phase of El Niño Southern Oscillation; however, increases in prevalence (percent infection, PI) precede sharp increases in intensity (weighted prevalence, WP) and epizootics of dermo in Louisiana can lag La Niña events by about 6 months (Soniat et al., 2005). Management techniques to minimize disease and increase oyster harvest include moving infected oysters to lower salinity, early harvest of infected populations, and even freshwater diversion into high-salinity estuaries. Because of the key role of dermo as a cause of oyster mortality, the success of oyster farming depends on the ability to manage oyster populations in the presence of high levels of disease (Soniat and Kortright, 1998).

The standard assay for determining the level of parasitism is the fluid thioglycollate method (Ray, 1966). A small piece tissue is removed and assayed for disease after incubation in fluid thioglycollate and antibiotics for one week. *P. marinus* intensity is scored using a 0-to-5 scale developed by Mackin (1962), where 0 is no infection and 5 is an infection in which the oyster tissue is almost entirely obscured by the parasite. Calculations are made of percent infection (PI) and weighted prevalence (WP), which is the sum of the disease code numbers divided by the total number of oysters in the sample. A WP of 1.5 could be considered a level at which disease-related mortalities are occurring (Mackin 1962, Bushek et al. 2012). Mackin (1962) claims a population of live oyster with a weighted prevalence of 2.0 “contains an intense epidemic, and more than half of the population may be in advanced stages of the disease, with all of the individuals infected”.

Eighteen sites across coastal Louisiana were sampled for oysters for the summer 2014 study. Samples were taken from Grand Pass (GP1N) and Three Mile Pass (TM) in Mississippi Sound; Lonesome Island (LI), Telegraph Point (TP), and Bay Crabe (BC) in the Breton Sound area; Mid Hackberry Bay (HB) in the Barataria system; Lake Felicity (LF) and Lake Chien (LC) in the Terrebonne Bay region; Grand Pass (GP5W) and Old Camp (OC) in Sister Lake; Buckskin Bayou (BB) and Rat Bayou (R) in Bay Junop; Nickle Reef and Lighthouse Point in the in Vermilion Bay region; West Rabbit Island (WR) and Commissary Point (CP) in Lake Calcasieu; and two stations in Sabine Lake (SL2 and SL3).

An attempt was made to assay 10 market-sized (≥ 75 mm) oysters and 10 seed (25-74 mm) oysters from each site. However, in some cases insufficient numbers of oysters were available to satisfy that standard (Table 1).

The length of oysters was measured to the nearest mm; anterior-ventral mantle tissue was removed from each oyster, incubated at room temperature in fluid thioglycollate for about a week, and assayed according to the standard Ray (1966) technique. The level of infection (disease code) was scored from 0 to 5, where 0 is no infection and 5 is near total coverage of the oyster tissue by the parasite. Weighted prevalence (WP) was calculated by summing the disease code values and dividing by the number of oysters in the sample.

Weighed prevalence (WP) and percent infection (PI) results are shown in Table 1. Where direct reef-to-reef comparisons were possible between results from 2014 and 2015, seed oysters from GP1N, LC, OC and BB showed increases, whereas TM showed a decrease in WP. For sack

Oysters; WP increased in 7 of 11 of direct comparisons (GP1N, TM, LI, LF, LC, GP5W, OC, and BB), whereas four stations showed a decrease in WP (TP, CP, S2 and S3). A notable increase in WP occurred in oysters from GP1N (0.40 in 2014 vs. 1.20 in 2015). An 80% infection rate and a WP of 1.20 may portend disease-related mortalities if salinities remain high or increase. Decreases in WP of sack oysters were more common in oysters from the western portion of the State (CSA 7) than from those in the eastern or central regions. Particularly noteworthy is the decrease in disease levels in oysters from Sabine Lake (S2 and S3). Complete records of disease levels from this year and previous years are available from Oyster Sentinel (www.oystersentinel.org).

Table 1. Percent Infection (PI) and Weighted Prevalence (WP) of seed and market-size oysters from Louisiana Public Seed Grounds: Summer 2015. Date is collection date, T = temperature, S = salinity, PI = percent infection, WP = weighted prevalence, NS = number of seed oysters assayed, NM = number of market oysters assayed. No data indicates that insufficient numbers of oysters were collected.

Station	Date	T (^oC)	S (ppt)	Seed PI	Seed WP	NS	Market PI	Market WP	NM
Grand Pass (CSA1N)	7/14/15	30.8	22.2	30	0.13	10	80	1.20	10
Three Mile Pass	7/14/15	30.5	12.4	10	0.03	10	20	0.07	10
Lonesome Island	7/15/15	30.2	9.3	no data	no data	0	10	0.03	10
Telegraph Point	7/16/15	28.1	19.4	no data	no data	0	10	0.03	10
Bay Crabe	7/15/15	29.3	14.0	no data	no data	0	10	0.03	10
Hackberry Bay (Mid)	7/7/15	26.9	14.8	10	0.03	10	50	0.40	10
Lake Felicity	7/14/15	30.7	13.4	no data	no data	0	20	0.20	10
Lake Chien	7/14/15	30.7	12.9	20	0.13	10	10	0.13	10
Grand Pass (CSA 5W)	7/14/15	30.5	12.4	0	0	10	10	0.03	10
Old Camp	7/14/15	30.8	14.2	20	0.07	10	10	0.03	10
Buckskin Bayou	7/14/15	29.8	6.1	50	0.20	10	10	0.03	10
Rat Bayou	7/14/15	30.6	16.2	no data	no data	0	20	0.10	10
Nickle Reef	7/27/15	31.1	28.7	no data	no data	0	10	0.03	10
Lighthouse Point	7/27/15	31.2	25.3	10	0.03	10	no data	no data	0
Commissary Point	7/27/15	31.8	7.8	no data	no data	0	0	0	10
W. Rabbit Island	7/27/15	31.7	20.2	no data	no data	0	60	0.40	10
Sabine Lake 2	7/27/15	31.0	21.0	no data	no data	0	0	0	10
Sabine Lake 3	7/27/15	31.1	20.5	no data	no data	0	0	0	10

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